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PLATOON-LEVEL BATTLEFIELD SIMULATION
Functional Requirements

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This research note contains the functional requirements for the Platoon-Level Battlefield Simulation (PLBS), which will be used for conducting research on how to train command, control, and communication skills in a cla-sroom environment. Included are the process and representation requirements for terrain, movement, detection/identification, engagement, indirect fire communications, resource audit, time, post-simulation, and initialization.

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FOREWARD

The US Army Research Institute is developing a research simulation designed to play the command and control (C^2) tasks attending armor platoon exercises such as Movement to Contact (STX E, FC 17-15-1), Hasty Attack (STX F, FC 17-15-1), and Defend a Battle Position (Task 3-IV-3-7 within the tank platoon mission "Defend"). This simulation, called Platoon-Level Battlefield Simulation (PLBS), builds on previous experience with a first prototype simulation called SIMCAT (Simulation in Combined Arms Training). PLBS is being designed to upgrade SIMCAT capabilities, capitalizing on lessons learned from research with the earlier system. PLBS will be microcomputer controlled, will have a separate player position for the platoon leader, platoon sergeant, and two tank commanders, and will have a free-play OPFOR station. Driving and gunnery will be under the control of simulated crewmen who are activated by voice commands or the control of a live second player at the station. A full 360^{o} terrain base will be accomplished using a map display without grid lines. Indirect fire, smoke, and concealed and artillery delivered mines will be available to both the friendly force and the OPFOR.

This report presents the functional requirements to be met in the development of the PLBS. It outlines, in detail, requirements for simulation control and development, terrain, movement of simulated vehicles, detection and identification, engagement, indirect fire, communication, and post-simulation feedback to soldiers being trained on the system.

This effort is part of the Fort Knox Field Unit's research program to apply new training technology to Armor skills training needs. The Field Unit's overall mission is to improve methodology basic to the derivation of Armor training and evaluation requirements and procedures, individual and collective training in Armor schoolds and operational units, and systems for integration and managing Armor training. A Memorandum of Agreement covering the application of training technology to Armor skills training was signed by TRADOC, USAARMC, and ARI on 4 Nov 83. Plans for the development of PLBS have been briefed to the DCG, USAARMC, and the CG, TRADOC for use in the MOS 19K Basic Noncommissioned Officer course. A similar effort is being coordinated with the Armor School for the Armor Officer Basic and Advanced courses. Plans have been made to pilot PLBS technology with the South Carolina National Guard.

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PLATOON-LEVEL BATTLEFIELD SIMULATION FUNCTIONAL REQUIREMENTS

INTRODUCTION

The purpose of this paper is to document the functional requirements for the Platoon-Level Battlefield Simulation (PLBS) system which will be used to conduct research on training command, control, and communications (C^3) skills among the four leaders of a tank or other vehicle platoon (i.e., the platoon leader, the platoon sergeant, and the two wingmen).

The first step in the development of a battle simulation is to define "what the system should do", or in the context of this document, to determine its functional requirements. PLBS must satisfy a multitude of vastly different functional requirements. To define these, some form of classification is required so that they can be organized and comprehensible. The functional requirements that have been prepared for PLBS are defined and recorded in this document and are organized into the following sections:

Initialization -- These functional requirements involve the system processes necessary to begin a PLBS simulation, e.g., identification of scenario conditions, speech enrollments, and definition of simulation variables.

Terrain -- These functional requirements involve providing each PLBS position with knowledge about the terrain in which he is operating, or, in the case of the Controller/Trainer, the terrain within which both the OPFOR and friendly forces are operating. These functional requirements are defined in terms of terrain characteristics, elevation, effects, and the perception requirements for each PLBS position.

Movement -- The process and representation requirements for movement are defined as they relate to the object that is moving, the rate of movement, the control of movement, and the perception of movement.

This document contains the functional requirements for PLBS (Platoon-Level Battlefield Simulation), a battle simulation being developed by Perceptronics, Inc., for the US Army Research Institute (ARI). PLBS is an upgraded version of SIMCAT (Simulation in Combined Arms Training). Most of the functional requirements for PLBS are identical to those originally developed by Human Resources Research Organization (HumRRO) for SIMCAT. The structure of this document, the system architecture, and most ot the functional requirements appeared originally in HumRRO Professional Paper 2-84, Specifying Battle simulation Requirement: A Model and Case History, authored by David L. Hannaman. Wording from the Hannaman paper appears throughout this report. Since separate citations for each instance would be combersome, this footnote has been included to apprise the reader of the origins of the PLBS functional requirements.

Detection/Identification -- This category of functional requirements concerns the relevant objects, events, and conditions of the simulation environment that may be detected and possibly identified by each participant in a PLBS simulation.

Engagement -- The purpose of the functional requirements for engagement is to resolve all encounters between the military weapon systems being simulated in a scenario. An encounter, in this context, is defined as the firing of one or more OPFOR or friendly force weapon systems and the effect, if any, on the engaged target(s).

Indirect Fire -- Dedicated indirect fire support will be provided to each of the opposing forces (friendly and enemy) in all PLBS scenarios. To satisfy this requirement, PLBS must provide a means for requesting indirect fire, impacting indirect fires, and representing the effects to appropriate PLBS positions. The representation and process requirements necessary to satisfy each of these are discussed in detail.

Communication -- The communication functional requirements are specified in terms of a verbal communication capability, hand and arm signal capability, and special message capability.

Resources Audit -- These functional requirements dictate that PLBS maintain an audit of all friendly force munitions and fuel expended by each weapon system and vehicle simulated in a scenario. Given a specified allocation of fuel or munitions, PLBS must audit the expenditures of these resources as they occur and prevent further expenditures once a resource has been exhausted. PLBS must also allow for the resupply of munitions and fuel during a simulation run.

Time -- These functional requirements dictate that PLBS be sensitive to and represent two different types of time: simulation time and real time. Each of these types of time will be discussed and information on the functional requirements regarding simulation time will follow.

Post-Simulation -- These functional requirements specify the PLBS processes necessary to support Controller/Trainer responsibilities associated with providing feedback to the vehicle commanders. Post-simulation functional requirements are divided into three categories: visual playback, audio or communication playback, and hard copy outputs.

Status and Informational Displays -- These functional requirements specify content requirements for the PLBS status and informational displays necessary for each of the participants.

Environmental -- This section describes the physical requirements for the environment of PLBS. Environmental requirements, as discussed in this section, apply only to the physical makeup of each workstation.

To understand the functional requirements discussed in the remaining sections of this document, a general understanding of the PLBS configuration is necessary.

The PLBS hardware architecture consists of six (6) computer workstations connected through a local area network. Four (4) of the workstations are configured identically and serve as vehicle commander stations. One workstation is the Controller/Trainer station, and the last workstation is the OPFOR Controller workstation. All of the workstations consist of an IBM PC AT configured with an 80286 microprocessor, an 80287 math co-processor, 3MB of random access memory (RAM), a 1.2MB floppy diskette drive, an 20MB hard disk drive, a graphics subsystem, and various input/output (I/O) devices. The graphics subsystem at each workstation consists of a graphics board set, a video disc player, and a color monitor. The I/O devices at each of the vehicle commander stations consist of two joystick type devices (one for driving the vehicle and one for controlling the turret), one keypad device, and a voice recognition and playback device. The I/O devices at the Controller/Trainer station are a monochrome monitor, a mouse pointing device and a high-speed dot matrix printer. At the OPFOR Controller station, a monochrome monitor, a joystick type device (used as a pointing device and to control vehicle movement) and a keypad are the I/O devices. PLBS includes, independent of the workstations themselves, a radio communications system for voice communication between the PLBS participants.

The PLBS system will allow for simulation play in two modes; One Player Mode and Two Player Mode. The One Player Mode will consist of six (6) human interactors; a Controller/Trainer, an OPFOR Controller and four vehicle commanders each at separate stations. The crew members (drivers, loaders, and gunners) of the vehicle commander controlled vehicles will be simulated by the PLBS system. In the Two Player Mode, each of the vehicle commander stations will be augmented by a second human crew member; a driver/gunner. This driver/gunner will provide the necessary interface between the vehicle commander and the simulation to control vehicle movement (direction and speed) and to pass along gunnery commands (when the system is not in voice recognition mode).

The Controller/Trainer will be responsible for controlling the simulation and providing guidance and feedback to the vehicle commanders. The OPFOR Controller, in cooperation with the Controller/Trainer, will present the vehicle commanders with an active opposing force and/or additional members of a higher echelon unit. The four vehicle commanders are the platoon members for whom training is intended; both in the one and two player modes. PLBS will allow the vehicle commanders to command either a simulated

tank or personnel carrier. The OPFOR Controller will control the actions of up to ten (10) entities (enemy and/or additional friendly forces). The entities which can be controlled at the OPFOR station are: enemy tanks, friendly and enemy personnel carriers, friendly and enemy trucks, friendly and enemy helicopters, and enemy man-packed saggers.

Throughout this document, the Controller/Trainer station and/or the individual operating the Controller/Trainer station will be referred to as the "Controller." Similarly, the OPFOR station and/or the individual operating the OPFOR station will be referred to as the "OPFOR" and the Friendly Player Station (vehicle commander station) and/or the individual operating the Friendly Player Station (the person being trained on the system) will be referred to as the "TC."

For the purposes of this document the term "entity" shall refer to one of the following vehicles and/or weapon systems which will be simulated in PLBS:

TC Controlled Enties:

Friendly force tank with a main gun and a coaxial machinegun (discussed in terms of an M1 Abrams).

Friendly force personnel carrier with a TOW and a chain gun (discussed in terms of an M2/3 Bradley).

OPFOR Controlled Entities:

Friendly and enemy force tank with a main gun (enemy force tank is discussed in terms of a T72).

Friendly force personnel carrier with a TOW and a chain gun.

Enemy force personnel carrier with a Sagger and a main gun.

Friendly force helicopters with a TOW and a chain gun.

Enemy force helicopters with a sagger and a chain gun.

Enemy force man-packed-sagger.

Friendly and enemy force trucks with no weapon systems.

The remaining sections of this document define the functional requirements for the PLBS system.

INITIALIZATION

System initialization is the process by which the PLBS sytem is prepared for a simulation run. In addition to system

preparations, and to allow maximum flexibility for research and uses of PLBS, several simulation data elements shall also be accessable at or before simulation initialization. Those processes which are required at intialization and those which are optional together fall into the following four catagories:

Initial Conditions.

Modifiable Constants.

Databases.

Voice Enrollment.

Initial Condition

The Controller shall be provided with a means by which he may quickly and easily specify the initial or starting conditions of a simulation run. Those data elements which shall be user-definable in the initial conditions for a PLBS scenario are the following:

Scenario name/identifier.

Mission description.

Exercise type (platoon level, single tank, tank section, or company/team).

Names of participants, by station.

Friendly force indirect fire allocations and warning levels; by munition type (high explosive, scatterable mines, and smoke).

Terrain modifiers (blown bridges, closed roads, minefields, and barriers) and their locations.

Target reference points (locations and identifiers).

Control measures (phase lines, boundary lines, objectives, etc.) and their locations.

Forecasted routes.

Simulation history recording (on or off).

Simulation history recording interval.

A "yes" or "no" for inclusion of each of the following in the TC's status window:

Location (UTM).

Current fuel level.

Current munition levels.

Functionality (fully, engagement-only, movement-only, or dead).

Current terrain type.

Pending alerts/messages.

For each possible simulaton entity (4 TC controlled entities, 10 OPFOR controlled entities):

Is or is not in simulation.

Type of entity.

Initial location.

Initial orientation.

Initial turret orientation.

Thermal imagery sights capability.

For each TC controlled vehicle:

Starting and warning fuel level.

Starting and warning munitions levels (by weapon and munition type).

Resupply fuel amount.

Resupply munitions amount (by weapon/ammo type).

To facilitate the defintion of scenario initial conditions, a user-friendly, standalone program called Initial Conditions Generator (ICGen) shall be developed. This program shall have the following capabilities:

Create a new set of initial conditions.

Modifiy an existing set of initial conditions.

Place objects by positoning a cursor on a video map image.

Allow for freedom of movement around the video map terrain.

User shall be prompted for all information in a menu-driven, form-oriented manner.

ICGen shall be a Controller oriented, menu-driven, standalone program which will run either inside or outside of the simulation environment. Using ICGen, the Controller shall be able to quickly and easily create, modify or save one or more sets of initial

conditions. ICGen shall provide the capability for its user to precisely position objects on video map images, as well as describe, in detail, the characteristics of all simulation entities, terrain modifiers, control measures, forecasted paths, and target reference points.

The main menu of ICGen shall contain a list of all existing initial conditions files in a specified library. The user may select one of these files to be used for the default information, or may elect to create a completely new file from scratch. Once a file has been specified, a submenu shall be displayed on the monochrome monitor, and a map image along with any default graphics information shall be displayed on the color monitor. At this point the user shall have the ability to move around the simulation map area and/or select from the menu of options displayed on the monochrome monitor.

Using menu options and form-oriented data entry, on the monochrome monitor, the Controller will be directed through the creation of one or more initial conditions database file(s). The crosshair cursor on the color display will be used to position or locate items in the simulation world. Using the above techniques, the Controller shall have the ability to create, add, delete, and modify initial conditions files quickly and easily.

Adding to a file. When the ADD option is selected from the submenu, the user shall be presented with a list of objects which can be added. After selecting the object to be added, the Controller is directed to move the cursor crosshair to the desired location (or mulitple locations for items such as lines and minefields).

At this point, if more information is required about the object being placed, an input form shall be displayed on the monochrome monitor. This input form shall have fields for each piece of data which describes the object. When appropriate, default information shall be displayed. The Controller then moves freely among the input fields entering new data and/or altering the default data as desired. Rigid error checking shall be performed as information is entered to insure its validity. When an entry is deemed invalid, an error message shall be displayed indicating why it is invalid, along with a description of the valid range of data. When the form is completed and accepted, the graphics icon which represents the object being placed, shall appear on the color monitor, overlayed on the map image. The new entry shall automatically be added to the initial conditions file. The process can be repeated for all objects to be added to an initial conditions file.

Deleting an entry in the file. There shall be two ways in which an object can be deleted when the DELETE menu option is selected. Object deletion can be achieved by selecting from among a list of object names or by pointing to the icon. If the deletion

is to be made by object name, the user selects one or more object names from a list which is displayed on the monochrome monitor.

If the deletion is to be made by object icon, the user simply has to position the crosshair over the icon(s) of the object(s) to be deleted. When the deletion is accepted, by either of the above means, the graphic icon(s) on the color monitor are erased and the entry(s) are deleted from the initial conditions file.

Modifying an entry in a file. When the MODIFY option is selected, the object to be modified is selected by the same means used to delete an object; by icon or by object name. Once the object to be modified has been specified, the object can be moved and/or the information about the object can be changed on the input form displayed on the monochrome screen. Once the modifications have been made, the graphics on the color screen are redrawn and the entries in the database file are updated to reflect the modifications.

When the Controller is satisified with the initial conditions locations and descriptions, the file is saved, and the process can be repeated or the program terminated.

The ICGen program shall be invokable in two ways. First, by the single command "ICGen" at the DOS prompt level. When the program is executed in this manner it will be running outside of the PLBS. This provides a means to define one or more sets of initial conditions without the entire simulation running. Second, ICGen shall be executable within a simulation run, by selecting a menu option from the Controller's PLBS menu. Invoking the ICGen program shall not interfere with the operation/execution of the simulation. The Controller can either pause the simulation before entering the ICGen program, or allow the simulation to continue while modifying an initial conditions file. At the point which the ICGen menu option is selected, a snapshot of all object locations within the simulation shall be taken. This snapshot shall be saved as a time-stamped initial conditions file which can then be edited by the Controller while the simulation continues.

By allowing the Controller to access the ICGen software from within a simulation run, the Controller has the ability to present a given situation in a number of ways, easily and in a timely fashion.

An additional requirement is that the Controller must be able to create and place control measures such as boundry lines, phase lines, and objectives. To facilitate the creation and placement of control measures, ICGen shall allow for the addition and deletion of the following objects:

Lines.

Circles.

Boxes.

Text.

Lines shall be defined by selecting two or more points, a line width and a color. The Controller will use the pointing device to establish a sequence of points that are connected as they are plotted. A graphic "rubberband" line shall stretch from the last point plotted to the current crosshair location until the Controller presses a button on the pointing device.

Circles shall be defined by selecting a center point, a point on the perimeter, a line width, and a color.

Boxes shall be defined by selecting two points (opposite corners), a line width and a color. The Controller will again use the pointing device to select a point which will represent one corner of the box. A graphic "rubberband" box shall stretch from the selected point to the current crosshair location until the Controller presses a button on the pointing device.

Text shall be defined by selecting a point, one of two text sizes, a color, and the text itself.

Modifiable Constants

To provide maximum system flexibility, the following simulation data elements shall be modifiable through the use of a standard text editor:

Fuel consumption rates, by entity type -- the rate each type of entity consumes fuel -- effective at all times that an entity's engine is running (for TC controlled vehicles only).

Height of smoke -- effects line-of-sight by adding to the elevation.

Height of trees -- effects line-of-sight by adding to the elevation.

Height of entities -- effects line-of-sight by adding to the elevation.

Five pre-defined messages -- messages which may be sent to the Controller from the TC stations (80 characters or less).

Entity viewing range -- longest range at which an entity can identify another entity.

Weapon signature viewing range -- longest range at which an entity can identify weapon signatures.

Direct fire viewing range -- longest range at which an entity can identify direct fire.

Indirect fire viewing range -- longest range at which an entity can identify indirect fire.

Scatterable mines viewing range -- longest range at which an entity can identify scatterable mines.

Hand and arm signals viewing range -- longest range at which an entity can identify hand and arm signals.

Terrain modifier viewing range -- longest range at which an entity can identify terrain modifiers (blown bridges, closed roads, exposed minefields).

Smoke viewing range -- longest range at which an entity can identify smoke.

Maximum detection range -- longest range at which an entity can detect anything.

Absolute identification range -- longest range at which an entity can fully identify another entity.

Partial identification range -- longest range at which an entity can partially identify another entity.

No identificaton range -- longest range at which an entity can detect but cannot identify another entity.

Correct ammo loaded delay factor -- amount of time it takes the loader to respond to a gunnery command if the correct ammo is already loaded.

No ammo loaded delay factor -- amount of time it takes the loader to respond to a gunnery command if no ammo is loaded.

Wrong ammo loaded delay factor -- amount of time it takes the loader to respond to a gunnery command when the wrong ammo is loaded.

Number of salvos for friendly and enemy force indirect fire.

Radius of effect for indirect fire, by munition type.

Default indirect fire time on target -- from time of call by the Controller.

Time delay from the time smoke is layed (by indirect fire) until it has completely dissipated.

Degrees in engagement ID area -- degrees around the lay of a turret that the gunner can identify a target.

Degrees from turret lay for "closest target decision" (n) -- where "n" is used as follows: If more than one entity of the

announced target type exists within the "Degrees in engagement ID area" specified above, a determination must be made as to which of the entities should be engaged. To make this decision, the following protocol must be followed:

Determine which entity is closest to the lay of the turret.

If the entity selected is not within "n" number of degrees of the turret lay, that entity is selected for engagement.

If the entity selected is within "n" number of degrees of the turret lay, are there any other entities which are also within "n" number of degrees of the turret lay?

If any other entities are within "n" number of degrees of the turret lay, the entity selected for engagement of those entities within "n" number of degrees of the turret lay is the entity which is closest in range to the originator of the engagement (see section Engagement for a more detailed explanation of this modifiable constant).

Effective range for machineguns -- by type.

Area of coverage for M1 Abrams tank coaxial machinegun -- degree around the lay of the turret for coaxial machinegun spray.

The above data elements shall be described in detail, along with all possible values or ranges, in a standard modifiable text file.

Databases

PLBS shall utilize three main databases: a conflict resolution database, a maximum speeds database and a terrain database. Each will be discussed separately.

Conflict Resolution Database (CRD). The CRD contains probabilities of hit and damage given a hit, for all entity types, weapon/munition types, and indirect fire munition types. This database shall be a text file modifiable by a standard text editor.

Maximum Speed Database (SPEEDS). The SPEEDS database contains maximum forward and reverse speeds for each entity type, in each terrain type. This database shall be a text file modifiable by a standard text editor.

Terrain Database (AUTODAT). The terrain database contains feature and elevation data for each 30 x 30 meter subsection of the PBLS map area. This database shall be modifiable

through the use of an off-the-shelf software package called AUTODAT. [1]

Voice Enrollment

To utilize the voice recognition capability of PLBS, each TC must train the computer to recognize his voice. The process of teaching the computer a voice is called voice enrollment or voice training. Voice enrollment shall be accomplished by the use of off-the-shelf voice enrollment software augmented by a user-friendly interface. This interface shall allow a TC to enroll his voice for all necessary words quickly and easily by selecting from menus and reading on-screen directions. The voice enrollment process shall be facile enough to allow one Controller to oversee the simultaneous enrollment of four TC's.

TERRAIN

The functional requirements for terrain are to provide each position with knowledge of the terrain in which they are operating, or in the case of the Controller, the terrain in which both the OPFOR and friendly forces are operating. Terrain functional requirements are discussed below in terms of characteristics, elevation, effects and perception.

Characteristics

Terrain characteristics are the natural and/or man-made objects to be found in the tactical scenarios inherent in PLBS. PLBS shall provide for the representation of two types of terrain characteristics; terrain features and terrain modifiers.

Terrain Features. The terrain features shall describe the actual terrain itself, before any modifications to the terrain have been made. The terrain features which shall be represented are as follows:

Primary road.	Shallow water.
Secondary road.	Deep water.
Trail.	Clear.
Bridge.	Rough.
Light woods.	Cliff.
Heavy woods.	Barrier.

1 A description of AUTODAT can be found in Perceptronics, Inc. AUTODAT promotional literature.

Terrain features shall be described at a 30 meter resolution and contained in a database describing the video disc used for PLBS. This database shall be created/modified through the use of a user-friendly, standalone (outside of the simulation) program, called AUTODAT, designed specifically to digitize the terrain and elevation of video disc maps.

The representation of terrain shall be achieved by the display of fixed, non-modifiable, video disc map imagery on a color monitor.

Terrain Modifiers. Terrain modifiers shall describe changes to the terrain features. The terrain modifiers which shall be represented are as follows:

Blown bridge.

Closed Road.

Minefield (hidden and exposed).

Barrier.

The placement of terrain modifiers, at a 30 meter resolution, shall be achieved, at simulation initialization, through the use of a user-friendly, standalone program, called ICGen (see section Initialization for a description of the functional requirements for ICGen).

Terrain modifiers (except for hidden minefields) shall be represented by graphic icons overlayed on the video disc map imagery. An icon, representing the terrain modifier, shall be displayed in each 30 x 30 meter terrain feature grid which is changed by a terrain modifier. Detection and identification factors shall be considered in determining whether or not to display terrain modifiers (see section Detection/Identification).

Elevation

Elevation is the height above the level of the sea. Elevation shall be described, in increments of 10 meters, at a 30 meter resolution and contained in a database describing the video disc used for PLBS. This database shall be created/modified through the use of a user-friendly, standalone (outside of the simulation) program, called AUTODAT, designed specifically to digitize the terrain and elevation of video disc maps. The representation of elevation shall be achieved by the display of fixed, non-modifiable, video disc map imagery on a color monitor.

Effects

Terrain characteristics and elevation have an effect on both trafficability and Detection/Identification.

Trafficability is the effect of terrain on movement rates and traversability (e.g., tanks can traverse open, relatively flat grasslands, but cannot traverse rivers). Trafficability functional requirements do not dictate any representation requirements, but dictate several modeling requirements (i.e., friendly tanks should not be permitted to move at 70KPH in wooded terrain). These modeling requirements are specified later in section Movement.

Detection/Identification concerns the effect of terrain characteristics and elevation on the detection and subsequent identification of objects, events, and conditions of the simulation environment. Detection/Identification requirements are specified later in section Detection/Identification.

Perception

Each PLBS position requires a somewhat different perception of terrain. This difference in perception only relates to the area or size of the piece (and, consequently the scale) of the terrain which is represented to each position. Perception requirements for each PLBS positon are described separately.

TC's -- Each TC shall have the ability to select from 3 different views of the terrain in which he is operating. Each view, close, middle and long range, shall be a different size, but all shall provide a 360^{o} "birds-eye" view of the terrain. Each view will be of a United States Geological Survey filmed map. The size of frames (what can be displayed on a screen at any given time) at each view shall be as follows:

Close Range -- 600 meters X 450 meters

Middle Range -- 3000 meters X 2250 meters

Long Range -- 6600 meters X 4950 meters

OPFOR -- The OPFOR station has the responsibility of controlling a number of entities. For each entity the OPFOR station is controlling, the OPFOR shall be able to view the terrain in exactly the same manner as the TC's. This means that for any entity controlled at the OPFOR station, the OPFOR shall be allowed to select from the 3 different views of the terrain in which the entity being controlled is operating.

Controller -- The Controller shall be allowed to select from one of 15 different views of the simulation terrain. These views are as follows:

Platoon Leader

Platoon Sergeant

Wingman 1 and 2

OPFOR Controlled Entity 1 through 10

Controller's World View

When any of the four TC views are selected, the terrain displayed shall be the terrain view which is currently being viewed by the station which is controlling the entity selected. This view shall be centered around the selected entity.

Example: The Platoon Leader's station is displaying the Close Range view. The Controller selects to view the Platoon Leader's display. The Controller's display is then changed to the Close Range view centered around the Platoon Leader's vehicle.

When any of the OPFOR views are selected, the terrain displayed shall be the terrain view which is, or would be viewed by the station which is controlling the entity selected. This view shall be centered around the selected entity.

Example: The OPFOR station is displaying the Close Range view for Entity #2. The Controller selects to view OPFOR controlled Entity #2's display. The Controller's display is then changed to the Close Range view centered around the OPFOR's Entity #2.

Example: The OPFOR station is displaying the Close Range view for Entity #2. The OPFOR changes to viewing his Entity #1 at the Long Range view. The Controller selects to view OPFOR controlled Entity #2's display. The Controller's display is then changed to the Close Range view centered around the OPFOR's Entity #2.

The Controller's World view is a topographical map with a frame size of 6000 meters x 4500 meters. When the Controller's World view is selected for the first time, during a simulation run, the World view is displayed centered around the Platoon Leader's vehicle. The Controller then has the ability to move freely around the World view by panning right, left, up or down. After exiting and reentering this mode, the World view is displayed at the same place it was previously exited from.

At all stations, after selecting one of the terrain views other than the Controller's World view, the frame displayed shall be a snap-shot of the terrain, at the selected view, centered around the vehicle being controlled. As the controlled vehicle approaches a boundry of the current frame, the display

shall be updated with a different frame to reflect the new surrounding terrain.

At any given time, an entire segment of terrain is visable to the TC's and the OPFOR without consideration of line-of-sight. Because the viewer can see more of the terrain features than would be viewable in the field, yet will only be allowed to see the terrain modifiers, entities, events and conditions which are within line-of-sight of the vehicle being controlled (see Section Detection/Identification), it is necessary to provide the viewer with some indication of what terrain is actually within line-of-sight. For this reason, while viewing any one of the terrain perspectives, the TC's and the OPFOR shall be provided with an option to call up a graphic display of line-of-sight. This display shall appear as an overlay on the video disc map image until an option to clear it is selected. This display shall be a 45 degree line-of-sight fan centered around the turret and extending from the controlled vehicle to the edge of the display. The fan shall consist of solid lines through those 30 x 30 meter terrain areas for which the viewer does not have line-of-sight, and no lines through those 30 x 30 meter terrain areas for which the viewer does have line-of-sight. To invoke this function the entity being controlled must be stationary.

MOVEMENT

Determining what moves, the rate at which something moves, the control of movement, and the perception of movement are all critical to PLBS achieving its objectives. The movement functional requirements vary, depending on the PLBS position being addressed, and will be discussed in the following subsections:

TC Vehicle Movement.

OPFOR Controlled Entity Movement.

Controller Movement Monitoring.

Each of these subsections will be discussed individually in terms of direction, rate, control, and perception. For purposes of this discussion, these terms are defined as follows:

Direction -- The line or course (expressed in terms of degrees) on which a vehicle moves.

Rate -- The speed at which a vehicle moves.

Control -- The manner in which both the direction and rate of movement for a vehicle are controlled.

Perception -- The visual image of vehicle movement.

TC Vehicle Movement

The platoon leader, platoon sergeant, and two wingman commanders will each control the movement of his own vehicle (tank or PC). In this context, movement includes both the direction in which a vehicle moves and its rate of speed. Specifically, this requires PLBS to satisfy the following functional requirements:

Direction -- Each TC shall be capable of moving his vechicle in any direction at any time during the simulation.

Rate -- PLBS shall limit the rate at which TC vehicles can move. The maximum forward and reverse rates of speed differ depending upon the type of vehicle being controlled (tank or PC) and the type of terrain (heavy woods, primary road, etc.) over which movement is taking place. The maximum speeds for each type of vehicle, in each type of terrain, for both forward and reverse movement, shall be specified in a modifable database called SPEEDS. This database shall be easily modifiable at the initialization stage of a simulation run (see section Initialization).

Control -- Control of TC vehicles dictate the following movement control functional requirements:

Engine Status -- Since vehicles consume fuel, vehicle commander's may choose to turn their engines off while stationary. For this reason, PLBS shall provide a means by which the TC's can control the running of their vehicle's engine. Each TC position shall be provided the ability to turn the vehicle engine to "off" and "on". In the two person mode, the vehicle commander will issue a voice command to the human driver/gunner to turn the engine "on" or "off". The human driver/gunner will then select the appropriate engine control in response. In the one person mode, the vehicle commander himself must select the appropriate engine control to turn the engine either "on" or "off".

Movement Ability -- When a vehicle's engine is not running, the vehicle is out of fuel, the vehicle is engagement-only functional (tracks have been blown off), or the vehicle is dead, all movement capability is disabled.

Controlling Direction and Rate -- Each TC shall have control of both the direction and rate at which his vehicle is moving. To achieve this, PLBS shall provide each TC station with the capability of direct vehicle movement control.

In the two person mode, the vehicle commander will present verbal directives to the human driver/gunner. The human driver/gunner will then take the necessary action to control the movement of the vehicle. In the one person mode, the vehicle commander himself must take the necessary action to control the movement of his vehicle.

To facilitate direct movement control, a joystick type device shall be utilized which will facilitate both direction and speed control. This input device shall be the same for both modes of operation (single and two person).

Directional control shall facilitate directional changes as small as 15 degrees as well as forward and reverse movement.

Rate control shall facilitate speed adjustments as small as 5 KPH up to the previously specified maximum rate of speed for the vehicle type in the terrain being traversed.

Perception -- Each TC must always be aware of the following regarding his tank:

Tank Orientation -- Because the TC must be aware of the orientation of his vehicle before he can determine the appropriate directional changes to be made, the front of a TC's vehicle must always be indicated. To achieve this, PLBS shall represent the vehicle, on the TC's display, in a manner which clearly identifies the front of the vehicle (e.g. for a tank this shall be a rectangle with a notch cut out at the front).

Direction of Movement -- TC's must be made aware of the direction of that movement. This shall be achieved by the repositioning (updating) of the vehicle icon on the TC's display as it moves across the terrain.

Rate of Movement -- Each TC must be capable of discerning the movement rate of his vehicle. To accomplish this, a speed indicator shall be present on the TC's display. The speed indicator shall be a graphic representation of speed overlayed on the color monitor. When the vehicle is not moving the speed indicator shall read "0". When the vehicle is moving, the speed indicator shall be a number which represents the number of kilometers per hour (KPH) at which the vehicle is travelling (e.g. "25").

Engine Status -- PLBS shall provide a constant cue to each TC signifying whether or not the engine on his vehicle is running. This shall be accomplished by the absence or presence of the speed indicator. The speed indicator shall be present if the engine of the vehicle is turned on and shall not be present if the engine is off.

OPFOR Vehicle Movement

One person will control the movement of all OPFOR controlled entities (i.e., friendly and enemy tanks, friendly and enemy PC's, friendly and enemy trucks, friendly and enemy helicopters, and enemy man-packed saggers). PLBS, therefore, must provide the OPFOR the capability to move his vehicles both individually and together

as a group. This dictates the following OPFOR vehicle movement functional requirements:

Direction -- At any point on a terrain representation, and at any time during the simulation, the OPFOR must be capable of moving any of the entities he controls in any direction. He must be permitted to move each of his entities individually as well as in unison.

Rate -- Rates of movement shall be limitied for OPFOR controlled entities in the same manner as for TC vehicles (see TC Vehicle Movement: Rate).

Control -- Control of OPFOR controlled entities dictate the following movement control requirements:

Engine Status -- If present, OPFOR controlled entity engines shall always be assumed to be running. Therefore, the OPFOR need not be provided with engine control capability.

Movement Ability -- Engines of the OPFOR controlled entities shall always be running, and fuel shall not be monitored. When an OPFOR controlled entity is engagement-only functional (tracks have been blown off) or the enitity is dead, all movement capability is disabled.

Controlling Direction and Rate -- OPFOR entity movement control shall allow for individual entity and group control. This requires that the PLBS allow the OPFOR to group (and disband) two or more entities. PLBS shall allow the OPFOR to select the grouping option, and subsequently denote which entities shall be included in the group. Up to 5 groups shall be allowed. When entities are grouped, a directional command given to any member of the group shall effect the entire group.

The OPFOR must have the flexiblity of either directly controlling the movement of an entity or a group of entities, or forcasting a route for an entity or group of entities to follow.

To facilitate forecasted path movement control, a combination of input devices shall be utilized: a joystick type device and a function keypad.

When the forecast route option is selected, the joystick device changes mode from direct movement control and is then used to select up to 25 discrete points. As the points are selected, they are connected to designate the route to follow. Once the forecasted route has been designated, the joystick device then reverts back to direct movement control mode and an indicator showing which entities are in forecasted mode is displayed on the OPFOR status display. Only speed control via the joystick device shall be allowed

while a vehicle is following a forecasted path. If a directional change is made via the joystick device, the forecasted path shall be aborted. Upon reaching the end of a forecasted route the entity shall cease to move. Unless direct speed control is initiated, the entity will attempt to always travel at the maximum speed for the terrain type being traversed.

Direct movement control shall be the same for the OPFOR as it is for the TC's (see section TC Vehicle Movement: Control) with the following exceptions:

When the OPFOR issues a movement command (either direct or forecasted), these commands shall effect either a single entity, or, in the case where the entity being commanded is a member of a group, shall effect all group members.

For group movement, the speed of all entities of a group is assumed to be the speed at which the slowest entity is moving (based upon both vehicle type and terrain type).

Perception -- The OPFOR must be aware of the location and movement of each of the vehicles under his control at all times. Line of sight or intervisibility among OPFOR vehicles is not of concern. Therefore, all OPFOR controlled entities shall be displayed, if possible, on the OPFOR display without regard to detection and identification considerations (see section Detection/Identification). Entity orientation, direction of movement, and rate of movement shall be represented in the same fashion as for the TC's.

Controller Movement Monitoring

A single individual will be responsible for controlling the entire simulation. With respect to movement functional requirements for PLBS, it is the monitoring responsibilities of the Controller that are of most concern. To assess tactical situations and provide proper feedback to TC's, the Controller must always be aware of what is moving, in what direction and at what speed. This necessitates that PLBS satisfy the following functional requirements:

Direction -- The Controller must be aware at all times of the direction of movement of all entities (friendly and OPFOR) in the simulation.

Rate -- The Controller must be aware of the movement rate of each entity in the simulation.

Control -- The Controller shall not have any control over the direction of movement or movement rate of either OPFOR or friendly forces.

Perception -- The Controller must always be aware of the following:

Vehicle Orientation -- The front of any friendly and OPFOR entities must be obvious to the Controller.

Movement -- The direction in which any simulation entity is moving must be portrayed to the Controller.

Movement Rate -- The movement rate of any simulation entity must be discernable to the Controller. This does not necessarily dictate that all movement must be depicted to scale nor depicted in continuous motion. For example, a symbol could move in 1/4 inch increments as opposed to moving continuously at an extremely slow, possibly nondetectable, rate. However, the Controller shall be able to distinguish rapid from slow movement rates.

DETECTION/IDENTIFICATION

These functional requirements concern the relevant objects, events, and conditions of the simulation environment which may be detected and subsequently identified by each participant in PLBS. These functional requirements not only concern what can be seen and heard, but also address the manner in which the stimuli are to be represented to the PLBS positions. In general, these functional requirements consider the detection of the following:

Entities -- Tanks, personnel carriers, trucks, helicopters, and man-packed saggers.

Instantaneous Events -- Weapons signatures, explosions, and other noises and flashes.

Transient Conditions -- Smoke.

These functional requirements also address how to determine when detection has been lost by each PLBS position.

It should be noted that detection, in this context, is not restricted to detecting or not detecting only opponent forces (i.e., OPFOR detecting friendly forces and friendly forces detecting OPFOR forces). In this case, detection also means that TC controlled friendly forces shall have the ability to detect other vehicles in their platoon that are within their field of vision; and in the case of the OPFOR station, that all OPFOR controlled entities shall be represented to the OPFOR at all times regardless of line-of-sight restrictions. However, the OPFOR ability to detect TC friendly forces shall be restricted by line-of-sight and other considerations.

The Detection/Identification functional requirements for PLBS are best defined in terms of visual detection/identification, auditory detection, and representation requirements.

Visual Detection/Identification

To determine whether an OPFOR or friendly force entity detects something visually, and if it is detected how well it is identified, several factors must be taken into consideration. To determine detection, two questions must be answered: "Can it be detected?" and "Do they see it?" The first question is answered by determining whether or not line-of-sight exists between the objects in question. Terrain characteristics, elevation, vehicle height, and existance/height of obscurants (smoke) located between the potential viewer and the potentially detectable object shall be considered in determining line-of-sight. The height of vehicles and smoke shall be constants, modifiable at initialization (see section Initialization). If line-of-sight does exist, the second question, "Do they see it?", shall then be answered. The simulation shall answer the second question, "Do they see it?", by considering range. The "Do they see it?" element of detection shall be answered "yes" if the range between the viewer and object is less than the maximum detection range. This range shall be modifiable at system initialization (see section Initializaton).

If something is detected, the degree of identification shall then be determined. PLBS shall provide three degrees of identification: absolute identification, partial identification, and no identification. Each of these degrees shall be based upon range. Each of these three maximum ranges shall be modifiable at system initialization (see section Initialization).

In determining detection and identification, PLBS shall utilize the following set of rules for each type of potentially detectable and identifiable objects:

> Entities -- At the TC stations, entities shall be detected only if they are within the line-of-sight and entity viewing range of the TC's vehicle. The degree of identification shall be based upon the distance between the TC's vehicle and the entity detected. At the OPFOR station, TC vehicles shall be detected only if they are within the line-of-sight and entity viewing range of the selected OPFOR controlled entity. The degree of identification shall be based upon the distance between the selected OPFOR controlled entity and the TC vehicle detected. All OPFOR controlled entities shall always be detected and fully identified by the selected OPFOR controlled entity at the OPFOR station.
>
> Weapon Signatures -- At the TC stations, weapon signatures from all entities (friendly and enemy) shall be detected: 1) if the entity firing the weapon is within the line-of-sight and weapon signature viewing range of the TC's vehicle, or 2)

if the entity firing the weapon is not within line-of-sight, but is firing at the TC's vehicle. The degree of identification, given detection, shall always be full identification. At the OPFOR station, weapon signatures from TC weapon systems shall be detected: 1) if the TC vehicle firing the weapon is within the line-of-sight and weapon signature viewing range of the selected OPFOR controlled entity, or 2) if the TC vehicle firing the weapon is not within line-of-sight, but is firing at the selected OPFOR controlled entity. The degree of identification, given detection, shall always be full identification. Weapon signatures from OPFOR controlled weapon systems shall always be detected by the selected OPFOR controlled entity. The degree of identification, given detection, shall always be full identification.

Direct Fire Hits -- At the TC stations, explosions from direct fire hits shall only be detected if the entity being fired upon is within the line-of-sight and direct fire viewing range of the TC's vehicle. The degree of identification, given detection, shall always be full identification. At the OPFOR station, explosions from direct fire hits on TC vehicles shall only be detected if the entity being fired upon is within the line-of-sight and direct fire viewing range of the selected OPFOR controlled entity. The degree of identification, given detection, shall always be full identification. Exposions from direct fire hits on OPFOR controlled entities shall always be detected by the selected OPFOR controlled entity. The degree of identification, given detection, shall always be full identification.

Indirect Fire -- At the TC stations, explosions from indirect fire shall only be detected if the 30 x 30 meter terrain area being fired upon is within the indirect fire viewing range of the TC's vehicle. The degree of identification, given detection, shall always be full identification. At the OPFOR station, explosions from indirect fire shall always be detected by the selected OPFOR controlled entity. The degree of identification, given detection, shall always be full identification. Once scatterable mines have been layed (by indirect fire) detection shall occur only if the 30 x 30 meter terrain area covered is within the scatterable mines viewing range of the entity being controlled. The degree of identification, given detection, shall always be full identification.

Hand and Arm Signals -- At the TC and OPFOR stations, hand and arm signals (from TC vehicles only) shall only be detected if the vehicle giving the signal is within the line-of-sight and hand and arm signal viewing range of the entity being controlled. The degree of identification, given detection, shall always be full identification.

Terrain Modifiers -- At the TC and OPFOR stations, terrain modifiers shall only be detected if the 30 x 30 meter terrain area which is modified is within the terrain modifier viewing range of the entity being controlled. The degree of identificaton, given detection, shall always be full identification.

Smoke -- At the TC stations, smoke shall only be detected if the 30 x 30 meter terrain area filled is within the smoke viewing range of the TC's vehicle. The degree of identification, given detection, shall always be full identification. At the OPFOR station, smoke shall always be detected by the selected OPFOR controlled entity. The degree of identification, given detection, shall always be full identification. Beyond the detection of smoke itself, is the effect of smoke on the detection and identification of other objects. If a entity has thermal imagery sights (TIS), smoke shall not affect that vehicles detection and identification capability since TIS enables sight through smoke. If an entity does not have TIS, line-of-sight will be affected by the area and height of the smoke.

The entity viewing range, weapon signature viewing range, direct fire viewing range, indirect fire viewing range, scatterable mines viewing range, hand and arm signal viewing range, terrain modifier viewing range, smoke viewing range, full identification range, partial identification range, no identification range, and TIS capability shall be specified for each PLBS entity type. These data elements shall be modifiable constants which are accessable at initialization through the use of the ICGen program (see section Initialization). By modifying the above values the effects of vehicle sighting devices (binoculars, TIS) can be simulated.

Auditory Detection

An auditory cue shall be sounded when an entity receives a direct hit either from direct or indirect fire. The receiving fire cue shall only be sounded at the station controlling the fired upon and hit entity.

Representation Requirements

Given that PLBS has determined that the occupants of a PLBS entity (OPFOR and/or friendly) have visually detected something (e.g., vehicle or weapon signature) or are to be provided with an auditory cue, PLBS shall represent this cue in some way to the appropriate vehicle(s). Specifically, these cue representation requirements are as follows:

Auditory -- The auditory cue sounded shall be able to be heard while the TC or OPFOR player is wearing a CVC helmet or headset.

Location of Detected Object, Event, or Condition -- This representation requirement is twofold. First, PLBS shall designate to the detector the location of the object, event, or condition. Second, the system shall represent the object, event, or condition itself in a manner which permits the detector to distinguish it to some degree.

Identification of Object, Event, or Condition -- Because events and conditions are either detected and fully identified, or not detected at all, they shall be represented by PLBS in only one manner. Each event and condition shall be represented graphically by a uniquely identifiable icon. Entities, however, have three (3) different levels of identification, given detection. For each type of entity, PLBS shall present three (3) different graphic representations; one for each identification level. The following table contains a description of the different degrees of identification and the resulting graphic representation:

Identification Level	Graphic Representation
Unidentified	Unrecognizible Entity (black square)
Partially Identified	Tank, PC, troops, truck, or helicopter (green icons)
Fully Identified	Tank, PC, troops, truck, or helicopter (red or blue icons)

At the fully identified level, TC vehicles shall be distinguished not only by the type of vehicle they are, but also by which member they are of the platoon. This shall be accomplished by displaying the turret of each TC vehicle in a different color.

Loss of Detection/Identification -- PLBS shall provide some form of notification that detection of an object has been lost or identification has been degraded. This shall be achieved by eliminating or changing the graphic portrayal of the object for which detection has been lost or identification has been degraded.

Detection and identification shall not limit what can be viewed at the World View for the Controller station. At any time during a simulation run, the Controller shall be allowed to select, or turn on and off, the display of each category of entities, events and conditions on this display. This will allow the Conroller to declutter his special view so that it contains only

the display of information which he is interested in at any given time.

The OPFOR needs to be alerted when any of the entities he is controlling detects a TC vehicle. For this reason, at the OPFOR station, when an OPFOR controlled entity detects a TC vehicle, the status line for the detecting entity, on the OPFOR status screen, shall be highlighted with an asterick.

ENGAGEMENT

The purpose of the engagement functional requirements for PLBS is to resolve all encounters between the military vehicles being simulated in a scenario. An encounter, in this context, is defined as the firing of one or more OPFOR or friendly force weapon systems. All entities with weapon systems shall be able to engage any other entities (enemy vs enemy, friendly vs friendly, friendly vs enemy, and enemy vs friendly). Engagement functional requirements involve five basic requirements. First, PLBS should model the operational characteristics associated with the use of various weapon systems, including variables such as reload times. Second, PLBS should model the potential effects resulting from the use of weapon systems including vehicle/equipment/weapon system damage and destruction. Third, the effects, if any, of a successful engagement by a weapon system (i.e., a hit) must be represented to the different PLBS positions (i.e., Controller, OPFOR, and TC's) with varying degrees of specificity. For example, if one tank engages another and obtains a direct hit, the tank that was hit certainly would know that his turret is no longer functioning, while the tank firing the round would not necessarily be aware of this fact. Fourth, the detectable events and conditions created as a result of a weapon system firing (i.e., weapon signature, impact of munitions) must be represented to the appropriate PLBS positions. Fifth, PLBS must maintain an audit of the amount of munitions expended by each friendly weapon system. PLBS engagement functional requirements can be specified best by addressing each of the following individually:

Weapon Systems Involved.

TC Controlled Weapon Systems.

OPFOR Controlled Weapon Systems.

Weapon Effects Modeling.

Representation Requirements.

Weapon Systems Involved

One of the most critical factors or variables that must be considered in the development of engagement modeling and

representation processes is the weapon system involved. The weapon systems which shall be modeled in PLBS are as follows:

Host	Weapon Systems
Trainee Controlled:	
M1 Abrams Tank	Main Gun (Heat and Sabot) and Coax
Bradley M2/3	TOW, 25mm Chain Gun
OPFOR Controlled:	
T72 Tank	Main Gun (Heat and Sabot)
Friendly Tank	Main Gun (Heat and Sabot)
Enemy PC	Sagger, 75mm Main Gun
Enemy Helicopter	Sagger, 25mm Chain Gun
Friendly Helicopter	TOW, 25mm Chain Gun
Man-Packed Sagger	Sagger

The Controller shall be permitted, at initialization, to specify starting loads for each of the above weapon systems.

TC Controlled Weapon Systems

Each PLBS TC station will control one of two entities: a tank or a personnel carrier (PC). The weapon systems of each will be discussed individually.

M1 Abrams Tank Weapon Systems. Each PLBS TC position shall have total control of the weapon systems at that position. An M1 tank has four weapon systems aboard: the tank main gun, a coaxial machinegun, a .50 caliber machinegun, and the loader's 7.62mm machinegun. Only the main gun and the coaxial machinegun will be simulated in PLBS.

On an M1 tank, the main gun and coax can be fired by either the gunner or the TC. In PLBS only the gunner will be permitted to fire the main gun and coax.

Orientation of M1 Abrams Tank Weapon Systems. The TC is responsible for the rough orientation of the main gun and the coax. PLBS shall provide the following functions associated with weapon system orientation, discussed in terms of direction, rate, control, and perception:

> Direction -- At any point, the TC shall be able to position the weapon systems in any direction, given that they are operational. He shall be able to do this whether the tank is stationary or moving.
>
> Rate -- The speed of weapon system orientation is not of great concern in PLBS. However, it shall neither require

a great deal of time nor occur at such a rapid rate that it is difficult to control.

Control -- The mechanism used to position the weapon systems shall be a joystick like device. This one device shall control the movement/orientation of the turret to which both weapon systems are attached (individual weapon system orientation is not necessary).

Perception -- Each TC shall always be aware of the position of the main gun and coax turret. This shall be accomplished by extending a line from the center of the graphic tank representation in the direction of orientation.

Engaging With M1 Abrams Tank Main Gun and Coax. In a real tank, the main gun and coax can be controlled and fired by either the gunner or TC. As stated previously, in PLBS, the TC will not be permitted to actually fire either of these weapon systems. Instead, the TC will issue fire commands to his crew (simulated or human). In PLBS, these fire commands shall be handled by one of two methods depending upon whether computer voice recognition is being utilized. If voice recognition is being utitilized, input to PLBS shall be via voice. If not, input to PLBS shall be via a keypad device.

In both the one and two person modes of play, when computer voice recognition is utilized, the TC shall issue voice gunnery commands, through his intercom, directly to the computer. In the one person mode, when computer voice recognition is not utilized, the TC shall issue gunnery commands by selecting a command on the keypad. In the two person mode, when computer voice recognition is not utilized, the TC shall issue voice gunnery commands, through his intercom, to the human driver/gunner. The human driver/gunner will then select the appropriate command on the keypad. In all modes of play, the crew responses to gunnery commands shall be accomplished through computer voice playback.

Once a TC has identified a target he wishes to engage with either the coax or the main gun, PLBS shall first allow the TC to traverse the turret so that the main gun, and coax are pointed in the general direction of the target. Once this has been accomplished, PLBS must accommodate a series of gunnery commands. The sequence of commands and the functional requirements related to them are as follows:[1]

[1] For explanitory purposes, gunnery commands are described assuming either the two person mode or the one person mode with voice recognition. If the two person mode is being played without computer voice recognition, the human driver/gunner will select the appropriate option on the keypad. If the one person mode is being played without computer voice recognition, the TC will select the appropriate option on the keypad instead of issuing a voice command over the tank intercom.

TC Provides Alert to Gunner -- The TC will call out "Gunner!" over the tank intercom. This alert normally is provided at the same time the TC is traversing the turret in the general direction of the target. The purpose of the command is to alert the gunner that the TC wants him to engage a target.

TC Identifies Weapon System to Engage -- The gunner, having been alerted that he should prepare to engage a target, now must be told which weapon system (coax or main gun) he should use to engage the target. If the TC wants the gunner to engage the target with the coax, the TC's next command over the tank intercom will be simply, "Coax!". If the TC wants the gunner to engage the target with the tank main gun, the TC's next command over the tank intercom will be either "Heat!" or "Sabot!", specifying which of the two types of tank main gun rounds should be used.

TC Describes Target -- The TC will then describe over the tank intercom the target to be engaged (e.g., "Tank", "PC", "Truck", "Chopper").

For explanitory purposes, gunnery commands are described assuming either the two person mode or the one person mode with voice recognition. If the two person mode is being played without computer voice recognition, the human driver/gunner will select the appropriate option on the keypad. If the one person mode is being played without computer voice recognition, the TC will select the appropriate option on the keypad instead of issuing a voice command over the tank intercom.

Loader Announces Message -- After the appropriate load time delay, the loader will announce "Up!" when the round has been loaded. PLBS shall provide this message to the TC over the intercom. Three ammo load time delays shall be utilized: "No Ammo Loaded", "Ammo Already Loaded" and "Wrong Ammo Loaded". These time delay factors shall be constants specified for each weapon system for which they apply, and shall be modifiable at system initialization (see section Initialization).

If the supply of ammunition of the designated type is exhausted, the loader will announce "Out of Ammo!" and the engagement will be cancelled.

If the supply of ammunition of the designated type will fall below the alert level specified at initialization (see section Initialization), after firing the round the loader shall announce "Up - Running Low!".

Gunner Announces Message -- Once the simulated gunner has identified the target, PLBS must then provide the message "Identified!" from the gunner to the TC (over the intercom). The process by which the gunner (PLBS) identifies a target shall be as follows:

If only one entity of the announced target type exists within "n" number of degrees of the turret orientation by the TC, the gunner refines the placement of the gun tube directly on the identified target, and announces "Identified!".

If more than one entity of the announced target type exists within "n" number of degrees of the turret orientation by the TC, the gunner determines which of the specified target type entities is closest to the TC's orientation of the turret. If two entities are within "x" degrees of the TC's orientation of the turret, the Gunner selects the one which is closest to his vehicle. He then refines the placement of the gun tube directly on the identified target, and announces "Identified!".

If no target of the specified target type exists within "n" degrees of the turret orientation by the TC, the gunner announces "Cannot Identify!" and the engagement will be cancelled. The number of degrees (n) in the engagement identification area as well as the number of degrees (x) which denotes an area of closest target decision shall be constants which are modifiable at system initialization (see section Initialization).

TC Gives Fire Command -- Once the loader has said "Up" and the gunner has said "Identified" , the TC will give the command "Fire!". At this point, PLBS should cause the tank main gun or coax (depending on the weapon system specified by the TC earlier) to fire.

Gunner Gives Fire Response to TC -- If the tank main gun is to be fired, PLBS must output the message "On the Way!" from the gunner to the TC over the intercom.
Subsequent Firing Activity -- If the Coax is being fired, firing will cease only when the TC issues a "Cease Fire" command, the target moves out of line-of-sight, or the ammo is exhausted. If the ammo runs low, the loader shall announce "Low On Ammo!".

If the tank main gun is being fired, the gunner will have to provide feedback to the TC. This feedback will vary depending on whether or not the target was hit, as in the following situations:

If the target was hit, the gunner (i.e., PLBS) will tell the TC "Target - Re-engaging" (over the intercom) and will continue to fire until the target moves out of line-of-sight, the TC issues a "Cease Fire" command or the ammo is exahausted or the target is destroyed. If the ammo runs low, the loader shall announce "Low On Ammo!".

If the target was missed, the gunner (i.e., PLBS) will tell the TC "Re-engaging." Given that the gunner

will always be presumed to have seen the target and the relationship of the target to the area where his missed round impacted, the gunner will fire automatically at the target once again. This will continue until the target is hit, moves out of line-of-sight or the TC issues a "Cease Fire". If the ammo runs low, the loader shall announce "Low On Ammo!".

Control of the coaxial machinegun spray, or area of coverage, shall be a constant specified at initialization as a number of degrees. The degrees shall represent the offset from the coax machinegun orientation in both a clockwise and a counter-clockwise direction which the machinegun shall spray.

Bradley M2/3 Weapon Systems. PLBS shall simulate the TOW and 25mm Chain Gun of the PC. The gunner (simulated) shall actually fire these two weapons upon receiving commands from the vehicle commander.

Orientation of Bradley M2/3 Weapon Systems. It is the responsibility of the vehicle commander to roughly position the orientation of the TOW and 25mm Chain Gun. For this reason, PLBS shall provide the following functions associated with weapon system orientation, discussed in terms of direction, rate, control, and perception:

Direction -- At any point, the TC shall be able to position the weapon systems in any direction, given that they are operational. He shall be able to do this whether the vehicle is stationary or moving.

Rate -- The speed of weapon system orientation is not of great concern in PLBS. However, it shall neither require a great deal of time nor occur at such a rapid rate that it is difficult to control.

Control -- The mechanism used to position the weapon systems shall be a joystick like device. This one device shall control the movement/orientation of the turret to which both weapon systems are attached (individual weapon system orientation is not necessary).

Perception -- Each TC shall always be aware of the position of their TOW and 25mm Chain Gun. This shall be accomplished by extending a line from the center of the graphic PC representation in the direction of orientation.

Engaging With Bradley M2/3 TOW and 25mm Chain Gun. The vehicle commander will not be permitted to actually fire either the TOW or the 25mm chain gun. Instead, the vehicle commander will issue fire commands to his crew (simulated or human). In PLBS, these commands shall be handled by one of two methods depending upon whether computer voice recognition is being utilized. If

voice recognition is being utilized, input to PLBS shall be via voice. If not, input to PLBS shall be via a keypad device.

In both the one and two person modes of play, when computer voice recognition is utilized, the TC shall issue voice gunnery commands, through his intercom, directly to the computer. In the one person mode, when computer voice recognition is not utilized, the TC shall issue gunnery commands by selecting a command on the keypad. In the two person mode, when computer voice recognition is not utilized, the TC shall issue voice gunnery commands, through his intercom, to the human driver/gunner. The human driver/gunner will then select the appropriate command on the keypad. In all modes of play, the crew responses to gunnery commands shall be accomplished through computer voice playback.

Once a TC has identified a target he wishes to engage with either the the TOW or the 25mm chain gun, PLBS shall first allow the TC to traverse the turret so that the turret is pointed in the general direction of the target. Once this has been accomplished, PLBS must accommodate a series of TC gunnery commands. The sequence of commands and the functional requirements related to them are identical to the requirements stated previously for the tank main gun and coax, with the following exceptions:

> When the vehicle commander wants the gunner to engage the target with the TOW, his command over the intercom will be "Missile!". If the vehicle commander wants the gunner to engage the target with the Chain Gun, the command will be either "AP!" or "HE!".
>
> The loader shall not respond with "Up!" for the PC weapon systems.
>
> For subsequent firing activity, the TOW and Chain Gun shall be handled in the same manner as the M1 Abrams Main Gun.

OPFOR Controlled Weapon Systems. The individual occupying the PLBS OPFOR position will be provided at all times with representations of the location and movement of all OPFOR vehicles as specified in the sections on PLBS movement, terrain and detection/identification functional requirements. It is this condition that dictates most of the functional requirements associated with the control of OPFOR controlled weapon systems (which differ considerably from the functional requirements for TC weapon system control).

Orientation of OPFOR Controlled Weapon Systems. PLBS must provide the OPFOR the capability of either not controlling the weapon system orientation of those entities which he is controlling (both friendly and OPFOR forces) or allowing PLBS to control those weapon system orientations automatically.

Weapon system orientation for OPFOR controlled entities shall be assumed by PLBS. No direct user control is necessary. Weapon systems shall always be oriented in a forward direction unless engaging. When a entity is engaging, the weapon system shall be oriented in the direction of the target.

Engaging with OPFOR Controlled Weapon Systems. PLBS must provide the OPFOR the capability of controlling the weapon systems of those entities which is controlling (both friendly and OPFOR forces).

OPFOR weapon system control necessitates the following functional requirements:

Identification of Weapon Platform to Use -- Given that the OPFOR will have represented to him, at all times, the location of all his weapon system platforms (i.e., friendly and enemy PCs, friendly and enemy tanks, friendly and enemy helicopters and enemy man-packed saggers) as well as anything detected (i.e., potential targets) by each platform, he must have the ability to identify which weapon platform he wishes to fire.

Identification of Weapon System -- As stated previously, several weapon platforms will be controlled by the OPFOR. Only one tank weapon system (main gun) and one man-packed sagger weapon system (sagger) will be simulated. Therefore, when the OPFOR selects one of these entities as the weapon platform he wishes to fire, it will always be its sole weapon system that fires. However, should the OPFOR select a friendly or enemy PC helicopter as the weapon platform to engage a target, there are two weapon systems that could fire for each. A friendly PC could fire its TOW or its 25mm chain gun. A friendly helicopter could fire its TOW or its 25mm chain gun. An enemy PC could fire its sagger or its 75mm Main Gun. An enemy helicopter could fire its sagger or its 25mm chain gun. Therefore, whenever the OPFOR identifies one of these entities as the weapon platform to engage, PLBS must also permit him to select which weapon system he wishes to fire.

Target Identification -- PLBS shall provide the OPFOR a means by which he can identify the intended target. This means shall be a crosshair cursor toggled between possible targets. The OPFOR will simply toggle the crosshair to the desired target and assign it by selecting the accept target option.

Fire Command -- After selecting the weapon platform, the weapon system and ammo (if necessary), PLBS shall permit the OPFOR to select the FIRE option to initiate the engagement.

Weapon Effects Modeling. When one or more weapon systems engage a single target, PLBS must determine the effects of the weapon system(s) firing on the target engaged. Two subprocesses are involved: hit probabilities and, if the target is hit, consequential damage to the target. At a minimum, hit probabilities must consider the following variables:

Distance to target.

Type of target (e.g., "hard", "medium" or "soft").

Target disposition (e.g., stationary or moving).

Firer disposition (e.g., stationary or moving).

After having determined whether or not the target was hit, PLBS must next determine what damage, if any, the target suffered as a result. It should not be assumed that a target is destroyed anytime it is hit. Therefore, PLBS must consider the following variables to determine the extent of damage to the target that has been hit:

Type of impacting munitions (e.g., 105mm Heat, 25mm).

Number of rounds impacting (e.g., first or subsequent round).

Target vulnerability (e.g., the target's mobility).

Target type (e.g., type of armor, wheeled, or tracked).

Probabilities of "Hit" and subsequent damage, based upon the above conditions shall be specified in the Conflict Resolution Database (CRD). The CRD shall be modifiable at system initializaton (see section Initialization).

Representation Requirements. The Controller, the OPFOR, and all TC's shall be presented with visual and auditory representations of engagement actions. The engagement representation requirements for PLBS fall into three basic categories: weapon firing, impact of weapon rounds, and effect, if any, of impacting rounds. Specifically, these requirements dictate that when a PLBS entity fires a weapon, a weapon signature shall be displayed upon the firing entity icon, an in-flight representation shall be displayed between the firer and the target icons, and an impacting representation shall be displayed upon or around the target icon. The weapon signature and the in-flight representation shall differ for main gun, machinegun/chain gun and missile firings. The impacting representation shall only appear if an entity is hit. When an entity is fired upon and hit by direct fire, the station controlling this entity shall be presented with an auditory cue.

INDIRECT FIRE

Dedicated indirect fire support will be provided to both friendly and OPFOR forces in all PLBS scenarios. To satisfy its indirect fire functional requirements, PLBS must maintain a record of indirect fire allocations, provide a means for both the friendly and OPFOR forces to request indirect fire support, deliver/impact indirect fires, and represent the effects of indirect fire to all PLBS positions. Each of these requirements will be discussed individually.

Fire Support Allocations

No weapon system found on the battlefield has an inexhaustable supply of munitions. As a result, friendly force indirect fire weapon system usage should be tempered and controlled. For this reason, PLBS shall allow for the allocation of munitions, by type, at the initialization stage of a PLBS scenario. When the supply, specified at initialization, has been exhausted, PLBS will notify the Controller by an alert message (see section Communication for a discussion of alert message requirements). Enemy force indirect fire munitions shall be inexhaustable.

Friendly Force Indirect Fire Requests

Armor platoon leaders normally request indirect fire support in one of two ways: either by direct contact with a Fire Direction Center (FDC) using formal call for fire procedures, or through communications with a Fire Support Team Forward Observer (FIST FO) assigned to his company team. In the latter case, formal call for fire procedures are not required and communications are not regimented by sequencing or content protocols. PLBS will not concern itself with platoon leader/FDC calls for fire. All indirect fire support requests will be handled through communications between the platoon leader and/or the platoon sergeant and a FIST FO.

PLBS shall provide for three (3) munition types: High Explosive (HE), Scatterable Mines, and Smoke; three (3) mission types: Spotting Round, Fire For Effect, and Final Protective Fire; and three (3) target location methods: Polar, Grid, and Shift. In addition to unit-based target identificaton, PLBS shall support target reference points (TRP's) as a reference for target location. TRP's are placed and named during initialization (see section Initialization).

To define the functional requirements associated with friendly force indirect fire support, two areas will be addressed. The first area is concerned with the requirements associated with requesting an indirect fire mission. The second is the manner in which the requests are actually processed.

Indirect Fire Requests -- When either the platoon leader or the platoon sergeant decides to request an indirect fire

mission, he first will establish contact with the Company/ Team's FIST FO. This will be done on the Company/Team Net (see section Communication). The role of the FIST FO will be assumed by the PLBS Controller.

Given that the Controller may assume the role of the FIST FO, it will be his responsibility to ensure the indirect fire requests received from the platoon leader or platoon sergeant are properly processed.
Request Processing -- Having received an indirect fire request from either the platoon leader or platoon sergeant, the Controller (acting as the FIST FO) will be responsible for actually processing the request. Therefore, the Controller must be able to specify the following to the system:

Initial Indirect Fire Request

Mission Number -- Numeric identifier for indirect fire mission.

Observer or Known Point Identification -- Identification of location from which target is being located (platoon leader, platoon sergeant, or target reference point identifier name).

Mission Type -- Spotting round, fire for effect, or final protective fire.

Method of Target Location -- Polar, grid, or shift.

Direction and Distance -- In mils and meters (for polar or shift calls); or UTM locaton (for grid calls).

Target Description -- Optional text (used only in post simulation reports).

Munition Type -- High explosive, scatterable mines, or smoke.

Time on Target -- Time delay between request and impact (minutes, with optional default set at initialization).

Subsequent Indirect Fire Adjustment

Mission Number -- Numeric identifier for indirect fire mission.

Mission Type -- Spotting round, fire for effect, or final protective fire.

Adjustment - Left/Right and meter distance and/or Add/Drop and meter distance.

End Indirect Fire Mission

Mission Number - Numeric identifier for indirect fire mission.

It is not being suggested that formal call for fire procedures be established between the Controller and PLBS. To the contrary, the simplest and most expedient means of conveying this information to PLBS shall be used to avoid overburdening the Controller. To achieve this, the use of "fill-in-the-blank" forms and menus shall be used.

It will be necessary for the Controller to not only input initial indirect fire requests, but also to input adjustment requests following an initial request for fire input to PLBS.

PLBS shall allow for multiple indirect fire missions at any given time. For this reason, it will be necessary for the Controller to specifiy a mission number. By assigning a mission number to an initial indirect fire request, the Controller will then be able to request adjustments with a minimum of data input.

Because PLBS shall allow both initial and adjustment calls for fire, the Controller must be provided with a means by which to end an indirect fire mission in order to indicate that no additional adjustment will follow.

The number of salvos, if applicable, for all friendly force indirect fire, shall be identified at initialization (see section Initialization).

OPFOR Indirect Fire Requests

Given that there are no training objectives associated with the OPFOR, the fidelity of the procedures associated with requesting indirect fire support is of no concern.

In addition, because there is concern about limiting the procedural burdens placed on the OPFOR, the manner in which the OPFOR requests indirect fire support will differ greatly from the way the friendly forces request indirect fire support.

The individual occupying the PLBS OPFOR position should not be required to communicate with anyone to request indirect fire support. Instead, he will have total direct control over the request and placement of indirect fire. The OPFOR shall be provided with the same three (3) indirect fire options as the TC's: High Explosive, Scatterable Mines, and Smoke. Upon selection of one of these options, the OPFOR shall then be prompted to select a mission type: Spotting Round, Fire For Effect, or Rolling Barrage Fire. After mission type selection, the OPFOR shall be prompted to place his crosshair cursor over the desired impact location (two locations for Rolling Barrage Fire). After the location(s) have been selected, the time delay between an OPFOR request for indirect

fire and impact shall be a constant delay factor designated at initialization (see section Initialization). The number of salvos, if applicable, for all OPFOR indirect fire, shall be identified at initialization (see section Initialization).

Indirect Fire Delivery

Once the PLBS system has received an indirect fire request (from either the Controller or OPFOR), it must process the request. Specifically, these functional requirements involve the following:

Determining the eventual impact area and radius of effect of the requested fire. The radius of effect for each type of indirect fire shall be modifiable at system initializaton (see section Initialization).

Given the aforementioned, determining which of the OPFOR and friendly force vehicles should be provided with auditory and/or visual cues.

Appropriate timing of the events associated with an indirect fire request (e.g. time from shot to splash).

Providing the indirect fire requester (i.e., Controller or OPFOR) with both "Shot" and "Splash" messages at the appropriate times.

Maintaining a count of the number of rounds (by munition type) expended and remaining (for friendly force only) and, when allocations have been expended, informing the Controller.

Providing the appropriate visual and auditory cues (discussed in detail in the next section).

Assessing the effects, if any, on targets located in the impact area and providing appropriate cues accordingly. The various damage probabilities for each type of indirect fire, for each type of target, shall be modifiable at system initialization (see section Initialization).

If Scatterable Mines are placed, the terrain they occupy will become and remain active explosive areas.

If Smoke is placed, it shall remain active unitl the specified time has elapsed. The time delay before smoke dissipates shall be specified at intializaton.

Representation Requirements

Impacting fire may result in a requirement for PLBS to represent either a visual or auditory cue, or possibly both, to PLBS positions. The criteria regarding what would be represented should consider the same factors discussed in detail in the section on the PLBS detection/identification functional requirements.

As stated previously, once PLBS has determined where indirect fire should impact and has determined who or what can detect the impacting fire, PLBS must represent the appropriate cues to certain PLBS positions (if detected, identification is 100%). Each mission type and munition type shall be represented in a unique manner. The mission types shall be visually represented by one or more graphic icons respresenting either one (single round) or several (battery or rolling barrage) rounds. Three graphic icons shall be used, one each for High Explosive, Scatterable Mines, and Smoke. If an entity is hit by indirect fire, the station controlling that entity shall be presented with an auditory cue.

COMMUNICATION

The communication functional requirements for PLBS serve three primary purposes. First, they will permit the Controller to interact with other PLBS positions in order to control the simulation. Second, they will permit Controller to monitor tactically related communications for evaluation and feedback purposes. Third, they will provide PLBS TC's with a realistic tactical communications environment. Realism in this context means that the communication networks, the participants in those networks (i.e., PLBS positions and roles simulated by PLBS), and the means of communicating found in field tactical environments will be represented in PLBS. Communication functional requirements are divided into the following subsections:

Communication Network Participants.

Communication Networks.

Communication Network Selection.

Communication Network Jamming.

Communication Network Recording.

Hand and Arm Signals.

Textual Message Transfer/Alerts.

Communictation Network Participants

To understand the communication requirements for PLBS, it is first necessary to know what positions or roles will be communicating in each network as well as who or what will be assuming these roles. There are seven positions involved in the communication networks required by PLBS. Specifically, the positions involved and whoever or whatever will assume these participatory roles are as follows:

TC's -- These include the platoon leader, platoon sergeant, wingman-1 and wingman-2. The communication requirements of

these individuals will be restricted to those normally associated with their positions in a tactical situation.

Controller -- The Controller will have the ability to communicate with all TC's (individually and collectively).

OPFOR -- The individual playing the role of the OPFOR can control both friendly and enemy forces. For this reason he must have the ability to communicate with other members of the friendly force. In addition, the OPFOR must be able to communicate with the Controller for simulation control purposes.

Tank Driver -- The tank driver of concern here is the driver of the tank controlled by each TC, but not the driver of any tank controlled by the OPFOR. The driver of a TC controlled tank will be either a human driver or a simulated, computer-controlled role capable of recognizing TC driving commands (voice or joystick; related to direction and rate of movement). Specific requirements of this role are addressed in detail in the section of the movement functional requirements for PLBS.

Gunner/Loader -- The gunner/loader of concern here is the gunner/loader of the tank controlled by each TC, but not the gunner/loader of any tank controlled by the OPFOR. The gunner/loader of a TC controlled tank will be a simulated, computer-controlled role capable of recognizing firing commands and able to produce minimal voice outputs (i.e., "Identified" and "Up"). Specific voice input/output requirements are addressed in detail in the discussion of the engagement functional requirements for PLBS.

FIST FO -- The role of the FIST FO will be assumed by the Controller in the required communication network. The function of this role will be to receive and process indirect fire requests from the friendly force platoon leader and/or platoon sergeant.

Company/Team Leader -- The role of the friendly force company/team leader will be assumed by the Controller. The function of this role will be to provide normal company/team leader communications to the friendly force platoon leader and/or platoon sergeant and possibly to the OPFOR controlling friendly forces.

Communication Networks

For the purpose of this discussion, communication networks or nets will be discussed in terms of the participants who are to be provided with a capability to communicate with one another on the net and the purpose that the net is intended to serve. PLBS requires three communication nets: Platoon, Company/Team, and Intercom.

The purposes of the four main communication nets are as follows:

Platoon -- Tactical operations net used by all members of a platoon (i.e., TC's) for C^3 functions.

Company/Team -- Tactical operations net enabling communications between all vehicles of the company team. The primary purpose of this net for PLBS is to enable the Controller to role play a company team leader and FIST FO, thus providing the necessary interface in these roles with the platoon leader and/or platoon sergeant and possibly the OPFOR controlling friendly forces.

Intercom -- Involves satisfying communication requirements among each tank driver, gunner/loader and TC. The primary purpose of this net in PLBS is control of movement and fire.

Communication Network Selection

TC's. PLBS TC's shall have the capability of selecting and then transmitting and/or receiving on different communication nets. Therefore, each of these individuals must be provided with a means of selecting the communication net in which he wishes to transmit and/or receive/monitor.

Each TC shall be able to select and then access one of three PLBS nets: Platoon Net, Company/Team Net, or their individual Intercom Net. Specifically, their communication net selection requirements dictate that they have the capability to:

Simultaneously monitor both the Company/Team and Platoon Nets.

Monitor and transmit on the Company/Team Net.

Monitor and transmit on the Platoon Net.

Hear and talk on the Intercom Net.

They should not be permitted to transmit on more than one net at any given time.

At the TC stations the speaker and microphone utilized to communicate over the various networks shall be those which are provided in the government furnished Combat Vehicle Crewman (CVM) helmets. The communications control device used shall be government furnished C2298/VRC control boxes. Two helmets and two control boxes shall be available at each TC station. One for the TC and one for the human crew member (if present).

On the Intercom Net the TC shall be capable of talking to and hearing the simulated crew and the human crew member (if present) simultaneously. Each of the two control boxes at every TC station

have a five (5) position selector (ALL, A, INT ONLY, B, C). The TC's control box shall be utilized to select between the following network capabilities:

ALL	Monitor and transmit on the Platoon Net, monitor the Company/Team Net.
A	Monitor and transmit on the Platoon Net.
INT ONLY	Hear and talk on the Intercom Net.
B	Monitor and transmit on the Company/Team Net.
C	Monitor and transmit on the Company/Team Net, monitor the Platoon Net.

The TC's control box shall be modified to contain an additional switch. This switch shall be a two position switch to control the destination of communications over the Intercom Net. In one position, TC communications over the Intercom shall be routed to the computer. In the other position, TC communications over the Intercom shall not be routed to the computer.

The driver/gunner's communications control box shall be a dummy box which provides a mount/connection for the driver/gunner's CVC helmet. The driver/gunner shall always hear exactly what the TC hears and says over any network.

Controller. The Controller net selection requirements dictate that PLBS provide the Controller with the capability to:

Simultaneously monitor the Platoon and Company/Team Nets.

Simultaneously transmit over the Platoon and Company/Team Nets.

Monitor and transmit on the Company/Team Net.

Monitor and transmit on the Platoon Net.

The Controller shall utilize a light-weight, adjustable headset with earphone speakers and a microphone along with a foot pedal to activate transmit mode. The communications control shall be provided by a custom designed device which shall be utilized to select between the following network capabilities:

ALL	Monitor and transmit on the Platoon and Company/Team Nets.
PLATOON	Monitor the Platoon and Company/Team Nets and transmit on the Platoon Net.
COMPANY	Monitor the Platoon and Company/Team Nets and transmit on the Company/Team Net.

OPFOR. The OPFOR will be controlling not only enemy force entities, but also will be controlling friendly force entities. For this reason, the OPFOR must be allowed to communicate on the friendly force networks. The OPFOR shall have the capability of selecting and then transmitting and/or receiving on different communication nets. Therefore, the OPFOR must be provided with a means of selecting the communication net on which he wishes to transmit and/or receive/monitor.

The OPFOR shall be able to select and then access one of two PLBS nets: Platoon Net and Company/Team Net. Specifically, the OPFOR communication net selection requirements dictate the following:

Simultaneously monitor both the Company/Team and Platoon Nets.

Monitor and transmit on the Company/Team Net.

Monitor and transmit on the Platoon Net.

The OPFOR shall not be permitted to transmit on more than one net at any given time.

The OPFOR shall utilize a light-weight, adjustable headset with earphone speakers and a microphone along with a foot pedal to activate transmit mode.

The communications control device used shall be a government furnished C2298/VRC control box. The control box has a five (5) position selector (ALL, A, INT ONLY, B, C) which shall be utilized to select between the following network capabilities:

ALL	Monitor and transmit on the Platoon Net, monitor the Company/Team Net.
A	Monitor and transmit on the Platoon Net.
INT ONLY	Not used.
B	Monitor and transmit on the Company/Team Net.
C	Monitor and transmit on the Company/Net, monitor the Platoon Net.

Communication Network Jamming

Electronic Warfare (EW) is a very real threat on the modern battlefield and will be experienced at all Army echelons in combat. Therefore, jamming of PLBS communication networks is a requirement. The communication jamming functional requirements are as follows:

All jamming will be controlled by the Controller.

The Controller shall be provided with the ability to select the PLBS communication network to be jammed (selection alternatives are restricted to the Platoon and Company/Team Nets).

The Controller must have the ability both to initiate and terminate the jamming of a net.

Although jamming can manifest itself on a radio net in a variety of ways, (e.g., gulls, white noise, wobbler, stepped tones) PLBS shall simulate only white noise.

Jamming shall be accomplished by selecting the network to be jammed (Company/Team and/or Platoon) and the desired noise volume on the Controller's communication control device. The maximum white noise volume shall be well within comfortable human noise range. To eliminate white noise, the volume dial shall be turned off.

Communication Network Recording

The PLBS communication system must provide a means by which the Company/Team and Platoon networks can be recorded for subsequent playback. For this reason, the Controller's communication control box shall provide a jack for simultaneous recording of the Company/Team and Platoon networks. See section Post-Simulation for further details on network recording functional requirements.

Hand and Arm Signals

When tank platoons are involved in offensive operations, hand and arm signals are often used for tank platoon communications. Although they may occur less frequently, they are also used by tank platoons in defensive operations. Given their frequency and the ever present need for secure communication networks, PLBS shall permit and facilitate the use of hand and arm signals. Specifically, PLBS shall provide each of the TC positions with the ability to:

Choose the hand and arm signal he wishes to send.

Send a selected hand and arm signal.

Receive hand and arm signals.

Recognize or determine from whom the hand and arm signal is coming.

The graphic representation of hand and arm signals shall include a large hand and arm signal icon displayed in an upper corner of the screen, and a designator on the sending unit. This display shall last for a pre-specified amount time. The hand and

arm signal display time factor shall be a constant modifiable at initialization (see section Initialization).

The following hand and arm signals shall be incorporated in PLBS:

Wedge.	Travelling.
Line.	Travelling Overwatch.
Vee.	Contact Right.
Herringbone.	Contact Left.
Coil.	Staggered Column.
Bounding Overwatch.	Column.
Echelon Left.	Echelon Right.

Textual Message Transfer/Alerts

The Controller and the TC's shall be provided a means by which they can communicate typed textual messages.

The Controller shall be allowed to select one to four TC stations to which he wishes to send a textual message. After selecting the desired station(s), the Controller shall then be prompted to enter an eighty character or less message. The message shall then be transmitted to each of the selected TC stations. Upon arrival at a TC station, a Controller sent message shall cause an alert to be signified to the TC. An alert shall consist of both an auditory cue and a graphic symbol on his display which informs him that a message is awaiting his review. To review pending messages, the TC shall be allowed to select the display of his informational/status window. This window shall be displayed on the TC's screen until he selects the option for it to be erased. Once viewed, the message shall be cleared from the alert queue.

Each TC shall be allowed to select from among five (5) pre-defined messages to send to the Controller. These messages shall be defined at initialization (see section Initialization). To send a pre-defined message, the TC shall be allowed to select the "Send Message" option. After selection of this option, the TC shall be prompted to select from among the five (5) pre-defined messages. Once selected, the message shall then be transmitted to the Controller station. Upon arrival the message shall cause an alert to be signified to the Controller. An alert shall consist of both an auditory cue and the text "ALERT PENDING" displayed on his monochrome monitor. To review pending alerts, the Controller shall be allowed to select a display of alerts. The display on his monochrome monitor will then be updated to display all pending alerts along with an identifier for the initiator of each alert. Upon exiting this display, all pending alerts shall be emptied from the alerts queue.

Other alerts, such as low ammunition or fuel levels (for TC vehicles), shall be queued and displayed by the above described method. These alerts shall be automatically sent, at the appropriate times, to the Controller and the appropriate TC.

All alerts/messages shall be recorded in the simulation history for subsequent reporting purposes.

RESOURCES AUDIT

More often than not, events on a battlefield are a function of the resources (e.g., weapons, food, fuel) available to the combatants involved. These resources are not inexhaustable and, once expended, can change the course of a battle. The resources of concern to a military leader vary, depending primarily on variables such as time and distances involved.

PLBS must be sensitive to resources critical to the scenarios it will simulate. Therefore, PLBS shall maintain an audit of friendly force resources (i.e., what they started with, what has been expended, what remains, and when a resource has been exhausted).

An inventory of possible military resources would be an ambitious undertaking to develop as well as to reflect in the design of PLBS. However, as stated previously, the resources about which one should be concerned vary depending on the nature of the military mission (e.g., duration, distances) under question. In PLBS, the focus will be on armor platoon missions or operations involving relatively short periods of time and short traveling distances (e.g., 10 to 40 kilometers). Therefore, only munitions (i.e., basic loads and expenditures of weapon systems involved) and fuel resources (i.e., fuel capacities and fuel consumption rates of vehicles involved) will be of concern. Each of these resources and their resource audit functional requirements will be discussed individually.

Fuel Resource Audit Requirements

Although fuel resource audit functional requirements are critical to PLBS, accurate modeling of fuel consumption rules does not appear to be sufficiently important to warrant extensive development effort. It appears sufficient that fuel consumption be computed at an approximate level. The following are the PBLS fuel resource audit requirements:

> PLBS shall maintain an audit of the amount of fuel used by each TC vehicle (non-TC vehicle fuel shall not be tracked).
>
> Fuel shall be consumed at a constant rate, per unit of time, (specified, by vehicle type, at initialization) while an engine is running. Fuel shall not be consumed when an engine is not running. Starting or initial fuel levels for each TC

vehicle shall be specified at initialization by the Controller.

When a TC vehicle reaches a critical fuel level (specified at initialization) or when all fuel is exausted, PLBS shall inform both the Controller and the appropriate TC by issuing an alert (see section Communication for a description of alerts).

Provide a record at the conclusion of a simulation reflecting the starting fuel level as well as the amount of fuel expended and remaining for each TC vehicle in the simulation.

Munition Resource Audit Requirements

Given that each TC controlled weapon system involved in a PLBS scenario will have been identified, along with starting munition levels, during initialization, PLBS will be required to:

Maintain an audit of the munition expenditures of each TC controlled weapon system (i.e., rounds fired and rounds remaining).

Inform the Controller and appropriate TC when a weapon system has reached a critical ammo level or has exhausted a class of munitions, by issuing an alert to the appropriate stations (see section Communication for a description of alerts).

Provide a record at the conclusion of a simulation reflecting the amount and, if appropriate, type of munitions expended and remaining, as well as the starting levels, for each TC controlled weapon system in the simulation.

Resupply

Since fuel and munitions for TC vehicles are limited, and can therefore be exhausted, a means must be provide for the resupply of these elements. PLBS shall allow the Controller, through a menu-option, to resupply a TC vehicle with fuel and/or munitions. When fuel resupply is selected for a particular TC vehicle, that vehicle shall be resupplied with a previously specified amount of fuel. The fuel resupply amount shall be a modifiable constant specified at initialization. When munitions resupply is selected for a particular TC vehicle, the weapon system and munition type must be specified. The vehicle shall then be resupplied with the previously specified amount of the exhausted munition type. The resupply amount for each vehicle, by weapon system and ammuntion type, shall be constants modifiable at system initialization.

TIME

As a battle simulation a critical function of PLBS is the representation of time. Two types of time are important: real

time and simulation time. Each of these will be defined and discussed separately; information regarding the functional requirements related to simulation time will then follow.

Real time refers to the passing of time in the "real world" environment. It is continuous and cannot be controlled. It can be represented by a clock on the wall and, in terms of this discussion, it is external to PLBS. Real time relates solely to "real world" considerations; in the case of PLBS, these considerations relate to such things as when to be off the simulator, when to break for lunch, or how long it takes to complete a single PLBS scenario.

Simulation time, on the other hand, refers to the passage of time represented in PLBS's simulated tactical environment. This passage of time is a critical factor to the combatants (i.e., OPFOR and TC's) involved in the tactical situation. In such an environment, time is an important cue to the existence or nonexistence of an expected event. For example, given a request for indirect fire, the requestor expects certain events at certain times, such as impacting artillery. Another example would be the expectation of a platoon leader that the tanks in his platoon will simultaneously begin some activity at a specific time. Given that the Controller controls simulation time, OPFOR and TC's can easily lose track of time. For example, if they expect artillery to impact in two minutes and the Controller stops the simulation for five minutes and then begins it again, from their perspective, did the artillery impact three minutes ago or will it impact in two minutes?

Given that PLBS must provide all simulation positions (i.e., TC's, OPFOR, and Controller) with some perception of the passage of time within the tactical environment being simulated, certain PLBS simulation time functional requirements have been identified.

Simulation Time Requirements

PLBS must permit the Controller to stop a simulation at any point for training purposes (e.g., to point out an error made by a TC) and/or for administrative purposes. In addition, the Controller must have the ability to replay all or a portion of a PLBS simulation. Normally, this will be done at the conclusion of a simulation to show PLBS participants what occurred and to permit the Controller to review the just-completed simulation in order to determine what feedback should be provided to the TC's.

To satisfy these processes, there are several time-control functional requirements PLBS must satisfy. Specifically, the Controller must be capable of:

Specifying a specific simulation time he wishes to recall.

Having accessed a specific simulation time (i.e., a point in a just-completed simulation where the location of all

friendly and OPFOR vehicles are shown), accelerating or slowing down (i.e., decelerating) the replay of the simulation events (either forward or backward in time).

Stopping or freezing in place an in-process simulation or replay of a just-completed simulation.

Determining the simulation time (as defined previously) in either an in-progress simulation or a replay of a just-completed simulation.

While a simulation is in progress, PLBS must allow the Controller to note simulation times related to critical events or conditions that he may want to recall at the conclusion of the simulation. This capability will provide the Controller an easy and expedient means of noting points in the simulation (which may prove critical to feedback) without disrupting the flow and, therefore, the fidelity of the simulation.

Time Representation Requirements

Simulation time shall be presented at the Controller station using a digital time display. The participants must be made aware of the following:

The starting of time -- Participants must be made aware that simulation time has started (or restarted in the event that simulation time has been stopped by the Controller).

The stopping of time -- Participants must be made aware that simulation time has been stopped whenever the Controller decides to stop it.

The resetting of time -- If the Controller decides to reset simulation time to an earlier or later point, the participants must be made aware of this fact and must be told the point at which the time has been reset.

The above requirement shall be met by the Controller. He will inform all participants, over the communication network, that the simulation time has been started, restarted, stopped or reset. At the Controller station the display of simulation time shall appear at the top of the monochrome monitor.

Update Cycle

The update cycle is the interval at which simulation data is transferred to each PLBS position to keep all positions current in their knowledge of all appropriate simulation activities. PLBS shall maintain an update cycle, with four (4) TC and ten (10) OPFOR controlled entities active in a simulation run, of as close to one second as possible.

POST-SIMULATION

PLBS differs from a highly structured procedural or part-task trainer having predetermined conditions, actions, and standards. Instead, in PLBS only the initial conditions are set. As a result, a multitude of events, actions, and conditions will occur at a very rapid rate during the course of any single PLBS run. Added to this is the fact that the conditions, events, actions, and outcomes of each scenario simulated in PLBS will be unique, making the problem of "what" feedback to provide and "how" to provide it a serious issue. These conditions dictate that PLBS must provide the Controller access to various data in various forms (e.g., visual, audio, hard copy) from which he can determine what feedback to provide the TC's and how to provide it. The requirements associated with providing feedback have been labeled post-simulation functional requirements.

Post-simulation functional requirements are defined as the PLBS processes necessary to support the Controller responsibility to provide feedback to TC's. Post-simulation functional requirements fall into three categories: visual playback, audio or communications playback, and hard copy outputs.

Visual Playback Requirements

One critical aspect of providing feedback related to tactical environments is the ability to reconstruct events, actions, or conditions. In PLBS, each of the positions involved will be provided a different perspective of events as they occur. In addition, as the information processing capabilities of each position become overloaded during a simulation, the ability of the TC to recall events, conditions, or actions accurately will be severly limited. Therefore, PLBS must have the capability to record events, conditions, and actions as they occur. This recall requirement of PLBS, coupled with the need to reconstruct events, conditions, and actions, has resulted in the identification of the following visual playback functional requirements:

> The Controller shall be provided with an option, at initializaton, to set "Data Capture" on or off. If "Data Capture" is set on, the data capture interval must then be set (1 second - 5 minutes). When "Data Capture" is on, PLBS shall take a snap shot of the entire simulation at the set interval. These snap shots shall then be used to provide visual playback.
>
> The Controller must be able to specify a simulation time in hours and minutes (e.g., 1 hour, 31 minutes) and have PLBS recall the situation at that point in time in a just-completed or temporarily halted simulation.
>
> Given a simulation time, the Controller must be able to specify which perspective he wishes to see (i.e., whatever

was seen on the display of the Controller, OPFOR or any one of the TC's).

Given a simulation time, perspective and station selection, the Controller must have the ability to move forward or backward at either an accelerated or a decelerated rate.

Audio or Communications Playback Requirements

It is important that, at the conclusion of a simulation, the Controller be provided the ability to review (prior to providing feedback to TC's) and reconstruct (while providing feedback to TC's) communications which occurred during the just-completed or temporarily halted simulation. This need dictates that PLBS record communications that occurred during the simulation and provide the Controller the ability to access and recall it. Given these Controller feedback requirements, the following audio or communications post-simulation functional requirements have been identified:

The Controller must be able to select the recording option for the Company/Team and Platoon nets.

The Controller must be able to determine where, on the recording, he needs to position the playback to hear the activity recorded at a specific simulation time.

The playback of audio/communication net recordings shall be achieved through the speaker of the recording device and/or through the Controller's headset.

Hard Copy Output Requirements

Although the conditions, events, actions, and outcomes of each scenario simulated in PLBS will be unique, it can be anticipated that certain data may be critical when providing feedback to the TC's. These data requirements can be viewed as serving two purposes. First, they will provide the Controller with clues about both good and poor performance. As such, the data could prompt the Controller to look for additional information. Suppose, for example, that PLBS provided the Controller with a hard copy output outlining when (in simulation time) each friendly vehicle was destroyed or damaged and which OPFOR weapon system caused the destruction or damage. The Controller could use this data to identify the visual and audio or communication points (i.e., simulation time) that he should play back to determine what happened and what feedback, if any, should be provided. The pre-determined data could also be used in output form as direct feedback to the TC's, thereby providing each TC with a listing of the number, type and time he fired main gun rounds and the OPFOR casualties, if any, that resulted.

The post-simulation hard copy outputs for PLBS are fall into five catagories: general simulation summary, friendly force

summary, direct and indirect fire utilization summary, and vehicle path summary. Each of these is explained below.

General Simulation Summary -- This report shall provide a general summary of a completed simulation. The output shall contain the date and identification of the scenario played, type of exercise (platoon-level, single tank, tank section, or company-team), playing time (i.e., actual time required to "play" the simulation), simulation time (i.e., duration of the simulated scenario), and names of the individuals responsible for each of the PLBS positions. A sample of this output is shown in Figure 1.

Friendly Force Summary -- This report shall consist of three sections: mission, resources, and damage/destruction. The mission section shall identify the friendly force mission for the scenario played. The resources section shall identify the amount of direct and indirect fire allocated, utilized, and ending amounts, by player and weapon type/muniton type. The damage/destruction section of this report shall consist of a listing of each player's vehicle along with any damage received during the scenario. This listing shall include the simulation time, cause, location and type of any damage/destruction. This report shall contain a header which specifies the scenario identification. A sample of this output is shown in Figure 2.

Direct and Indirect Fire Utilization Summary -- This report shall consist of a chronological list of direct and indirect fire utilization by type (direct or indirect). This list shall include: unit identification and type (firer or requestor), location of unit (firer or requestor), target identification and type, location of target, weapon munition(s) fired, range between firer and target (direct fire only) and effects, if any, of fire. This report shall contain a header which specifies the scenario identification. A sample of this output is shown in Figure 3.

Vehicle Path Summary -- This output shall be a scaled graphics plot of the path one or more player vehicles followed during the entire simulation. The Controller shall be allowed to select from among the platoon leader, platoon sergeant, wingman #1 and/or wingman #2 to be included in a single print of this output. This output shall be either printed on, or transferable to, a transparent media so that it may be overlayed on a physical map of the simulation area.

At the end of a simulation run, the Controller shall be presented with the following three options for each report:

Write Report to File Only -- Selection of this option shall cause PLBS to write the specified report to disk for later review and printout.

GENERAL SIMULATION SUMMARY

PLAYING TIME : 1 hr, 57 min **SCENARIO** : A-04

SIMULATION TIME : 1 hr, 3 min **DATE** : 17 DEC 86

EXERCISE TYPE : Platoon-Level

PARTICIPANTS :

Controller : CPT G. L. Smith and 1LT D. D. Boss

OPFOR Controller : 1LT D. L. Jones

Platoon Leader : 2LT J. K. Ogus

2nd Crew Member : None

Platoon Sergeant : PSG A. D. Killer

2nd Crew Member : None

Wingman #1 : SSG A. T. Jeep

2nd Crew Member : None

Wingman #2 : SSG H. E. Quick

2nd Crew Member : None

FIGURE 1. Sample General Simulation Summary.

FRIENDLY FORCE SUMMARY

SCENARIO : A-04

MISSION : Hasty Defense

RESOURCES:

	Direct Fire						Indirect Fire			Fuel
	SABOT	HEAT	.50 Cal	7.62	TOW	25mm	HE	Smoke	Mine	Gals
Start										
PC	42	12	1500	500	0	0	50	15	5	350
PS	42	12	5000	8000	0	0	0	0	0	350
WM#1	42	12	5000	8000	0	0	0	0	0	350
WM#2	42	12	5000	8000	0	0	0	0	0	350
End										
PL	32	12	1000	1000	0	0	30	15	0	50
PS	24	6	2000	6000	0	0	0	0	0	70
WM#1	20	6	1000	2000	0	0	0	0	0	70
WM#2	15	4	4000	2000	0	0	0	0	0	30
Used										
PL	10	0	500	4000	0	0	20	0	5	300
PS	18	6	3000	2000	0	0	0	0	0	280
WM#1	22	6	4000	6000	0	0	0	0	0	280
WM#2	27	8	1000	6000	0	0	0	0	0	320

DAMAGE/DESTRUCTION:

	Time	Cause	UTM	Type of Kill
PL	-	-	-	-
PS	0110	OPFOR-3 Tank Main Gun	123456	Total
WM#1	0111	OPFOR-4 Tank Main Gun	123456	Mobility
WM#2	-	-	-	-

FIGURE 2. Sample Friendly Force Summary.

DIRECT AND INDIRECT FIRE UTILIZATION SUMMARY

SCENARIO : A-04

CHRONOLOGICAL LIST OF DIRECT AND INDIRECT FIRE:

Time*	Type	Unit	UTM	Target	UTM	Weapon	Range	Effects
0030	Indirect	OPFOR			123456	Arty/HE		None
0040	Direct	OPFOR-1 PC	123456	PL	123456	Sagger	2000	None
0045	Direct	PL	123456	OPFOR-1 PC	123456	Main Gun	2000	None
0046	Direct	WM#1	123456	OPFOR-1 PC	123456	Main Gun	2010	Total
0105	Indirect	PL			123456	Arty/HE		OPFOR-2 PC Fire-Power
0110	Direct	OPFOR-3 Tank	123456	PS	123456	Main Gun	1800	Total
0111	Direct	OPFOR-4 Tank	123456	WM#1	123456	MainGun	1700	Mobility

*Simulation Time

FIGURE 3.Sample Direct and Indirect Fire Utilization Summary.

Write Report to Printer Only -- Selection of this option shall cause PLBS to print the specified report. Later review or printout of this report shall not be possible.

Write Report to File and Printer -- Selection of this option shall cause PLBS to write the specified report both to a disk file and to the printer. When this option is selected, later review and/or printout of the report shall be possible.

STATUS AND INFORMATIONAL DISPLAYS

Each PLBS station needs to be informed of certain events and conditions which are not continuous and are best handled by special displays of information. These special display requirements will be discussed in terms of the display elements required for each station.

TC Displays

Each of the TC stations shall be provided with the following types of status and informational displays:

Engine Status and Speed -- the presence of a speed indicator shall mean that the vehicle engine is running; its absence means that the vehicle engine is not running. The speed indicator shall be a number representing the number of kilometers per hour at which the vehicle is moving. The speed indicator should read "0" for a stationary vehicle where engine is running. This indicator shall always be visable if the vehicle's engine is running.

Alert Cue -- the alert cue shall be displayed on the TC's screen when an alert (message from the system), or a message (from the Controller) is pending. Until the alert or message has been viewed, this cue shall not be removed from the TC's display.

Send Message -- when the TC selects the "Send Message" option, a display of the available messages (which can be sent to the Controller) shall be drawn on his screen. When he selects which message to send or the "CANCEL" option, this display shall be erased.

Special Window -- this window shall be displayed when the TC selects the "Status Window" option, and shall contain information on the status of the following elements:

Location -- current UTM location of TC's vehicle.

Current Fuel Level -- current number of gallons of fuel remaining.

Current Munition Levels -- current number of munitions remaining by weapon and ammo type.

Functionality -- current functional status; either fully functional, mobility only functional, fire power only functional, or dead.

Current Terrain Type -- current type of terrain vehicle is operating within (clear, heavy woods, etc.).

Alerts/Messages -- display of any pending alerts (sent by system) or messages (sent by Controller).

When the TC selects the "Status Window" option again, the special window shall be erased.

At system initialization, the Controller shall be provided the opportunity to select whether each of the elements described above for the "Status Window" shall be displayed.

OPFOR Displays

The OPFOR station shall be provided with a continuous display of information on his monochrome monitor. This display shall be updated, if necessary, every update cycle. The information contained in this display shall be the following:

Entity Status -- for each OPFOR controlled entity, the following status information shall be displayed:

Entity ID -- the entity identifier or name and type of entity.

Group Affiliation -- if the entity is grouped, a group identifier shall be displayed.

Forcasted Path Mode -- if, and only if, the entity is moving in the forcasted route mode, an indicator to that effect shall be displayed.

Functionality -- current functional status; either fully functional, mobility only functional, fire power only functional, or dead.

Current Terrain Type -- current type of terrain entity is operating within (clear, heavy woods, etc.).

Location -- current UTM location of the entity.

Line-Of-Sight -- if, and only if, the entity has line-of-sight with a TC vehicle, an indicator to that effect shall be displayed.

Entity Speed -- a number representing the number of kilometers per hour at which the entity is moving.

Controller Displays

One of the Controller's responsibilities is to guide and control the simulation. To do this, he has some unique informational display requirements. The Controller not only needs to be able to view the simulation world from the perspective of any one of the simulated entities, he also needs to be able to view the simulation environment without any restrictions what-so-ever (detection/identification restrictions); to view the entire simulation environment and all of its on-going activities. To provide the Controller with this ability, he must be allowed to select from a number of simulation perspectives (see section Terrain for a description of the Controller's possible terrain perspectives). The Controller's World View shall be the method by which the Controller can view the simulation world without restriction.

With this perspective, selected simulation entities, events, and conditions shall be displayed to the Controller from a "God's-eye" perspective. No detection or identification restrictions shall be placed on this view. The Controller shall be allowed to interactively select the desired combination of entities, events, and conditions which he desires to be displayed at this view. He shall be allowed to clutter/declutter his display by turning on and off the display of the following:

All TC Controlled Entites.

All OPFOR Controlled Enemy Entities.

All OPFOR Controlled Friendly Entities.

Vehicle Orientation.

Turret Orientation.

All TC Controlled Weapon Signatures.

All OPFOR Controlled Enemy Weapon Signatures.

All OPFOR Controlled Friendly Weapon Signatures.

All Direct Fire Explosions On TC Controlled Entities.

All Direct Fire Explosions On OPFOR Controlled Enemy Entities.

All Direct Fire Explosions On OPFOR Controlled Friendly Entities.

Friendly Indirect Fire Impacts.

Enemy Indirect Fire Impacts.

Hand and Arm Signals.

Smoke.

Terrain Modifiers.

Control Measures.

While the Controller is displaying the Controller's World View on the color monitor, the monochrome monitor shall display the following status information:

Indirect Fire -- remaining friendly force indirect fire allocations by munition type.

Simulation Time -- digital reading of simulation time in hours and minutes.

Entity Status -- for each simulation entity, the following status information shall be displayed (if applicable):

Entity ID -- the entity identifier or name and type of entity.

Engine Status and Speed -- the presence of a speed indicator shall mean that the vehicle engine is running; its absence means that the vehicle engine is not running. The speed indicator shall be a number representing the number of kilometers per hour a which the vehicle is moving. This indicator shall always be visable if the vehicle engine is running (OPFOR controlled entity engines are always running).

Current Fuel Level -- current number of gallons of fuel remaining (TC vehicles only).

Current Munition Levels -- current number of munitions remaining by weapon and ammo type (TC vehicles only).

Forcasted Path Mode -- if, and only if, the entity is moving in the forcasted route mode, an indicator to that effect shall be displayed in the special window (OPFOR entities only).

Functionality -- current functional status; either fully functional, mobility only functional, fire power only functional, or dead.

Current Terrain Type -- current type of terrain vehicle is operating within (clear, heavy woods, etc.).

While the Controller is displaying a particular entity perspective, the display on his monochrome monitor shall consist of the following status information:

Simulation Time -- digital reading of simulation time in hours and minutes.

Entity Status -- for the entity which the Controller is viewing the perspective of, the following status information shall be displayed (if applicable):

Entity ID -- the entity identifier or name and type of entity.

Engine Status and Speed -- the presence of a speed indicator shall mean that the vehicle engine is running; its absence means that the vehicle engine is not running. The speed indicator shall be a number representing the number of kilometers per hour at which the vehicle is moving. This indicator shall always be visable if the vehicle is running (OPFOR controlled entity engines are always running).

Current Fuel Level -- current number of gallons of fuel remaining (TC vehicles only).

Current Munition Levels -- current number of munitions remaining by weapon and ammo type (TC vehicles only).

Forcasted Path Mode -- if, and only if, the entity is moving in the forcasted route mode, an indicator to that effect shall be displayed in the special window. (OPFOR entities only).

Functionality -- current functional status; either fully functional, mobility only functional, fire-power-only functional, or dead.

Current Terrain Type -- current type of terrain vehicle is operating within (clear, heavy woods, etc.).

An alert cue shall be displayed on the Controller's monochrome monitor, independant of what view is currently displayed, when an alert (message from the system), or a message (from one of the TC's) is pending. This alert cue shall be removed after the Controller has viewed all pending alerts/messages.

Workstation Cabinet Requirements

It is important for the protection of the electronic components of the PLBS system that some provisions for mounting and protection are made. For this reason, PLBS shall be outfitted with a complete set of computer station housings which will double as workstations for the systems users. To fullfill this requirement the workstations provided shall meet the following minimum functional requirements.

General Requirements

Selected workstations shall be of a commercially available variety which will withstand heavier than normal use without visable degradation in appearance.

Workstations shall be configured in such a fashion as to place components out of easy reach of unauthorized personnel while leaving access for assigned operator(s).

Electronic components shall be mounted in a neat and attractive fashion, with all cables bundled and marked, switches and controls clearly visable and all visable surfaces of a non-marring washable material such as Formica®.

Cabinets and work surfaces shall be of a substance that will not generate static electricity and will protect against static discharge which could damage electronic components of the system.

Mounting for the color monitors at all stations shall be via a pintle type bracket which permits repositioning in any horizontal position. A horizontally articulated arm with an attached platform for the monitor is preferred.

Station cabinetry and equipment shall be two man portable with all electronic components removed. If components are not removable, durable casters with a lock-down feature must be provided.

Controller Station

Mounting for the following minimum equipment shall be provided:

One IBM PC/AT microcomputer with 2 monitors and a keyboard.

A video disc player.

A dot matrix printer with paper tray.

A communications system control panel.

One or more I/O devices (Mouse, Joystick, Keyport Keypad, etc.).

One or more cassette tape audio recording machines.

Sufficient work top space to permit recording of comments and related manual tasks shall be provided.

OPFOR Station

Mounting for the following minimum equipment shall be provided:

One IBM PC/AT microcomputer with two monitors and a keyboard.

A video disc player.

A communications system user panel.

One or more I/O devices (Mouse, Joystick, Keyport Keypad, etc.).

Sufficient worktop space for manual tasks shall be provided.

TC Stations (4)

Mounting for the following minimum equipment shall be provided:

One IBM PC/AT microcomputer with one color monitor.

A video disc player.

Three I/O devices (Two Joysticks, One Keyport Keypad).

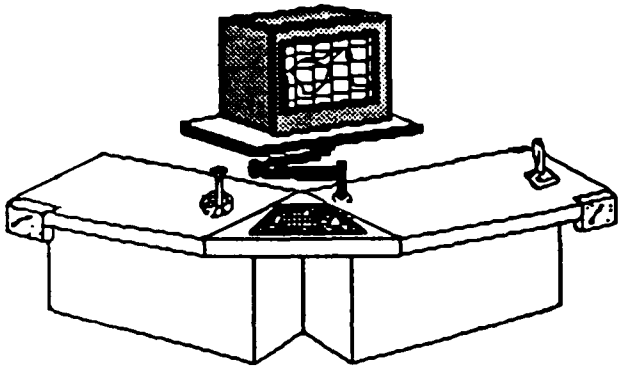
Sufficient worktop space to permit use of a tactical map and minimal manual tasks shall be provided.

Sufficient leg and arm space to permit two players to be situated comfortably around one color monitor shall be provided.

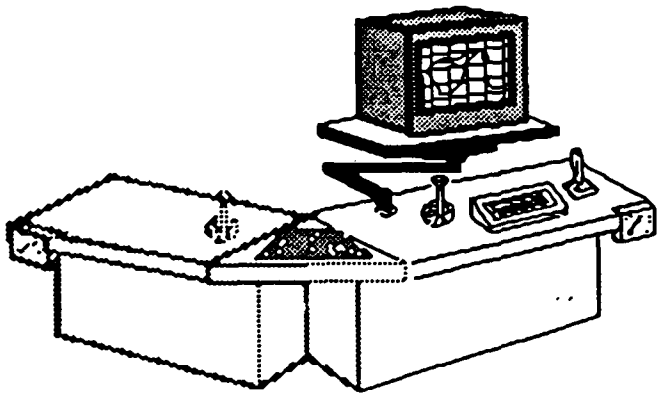
A facility shall be provided to mount two C-2298 communications control boxes. Mounting shall be such that the user has easy access to connect his helmet and operate the control switches.

Figure 4 depicts two alternatives for the TC workstations.

SEPARATED ALTERNATIVE

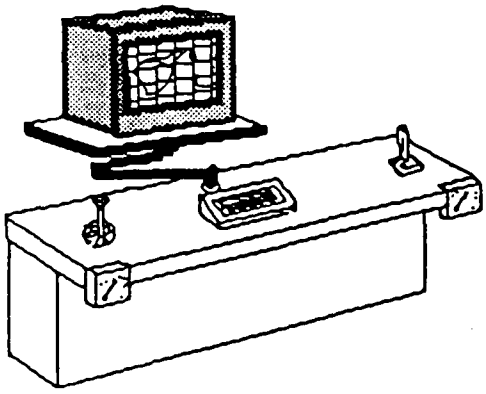


Two Player Mode

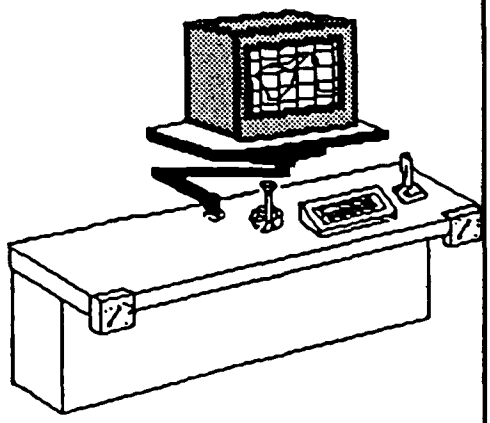


One Player Mode

SIDE - BY - SIDE ALTERNATIVE



Two Player Mode



One Player Mode

FIGURE 4. Trainee Workstation Alternatives